PLASTICS

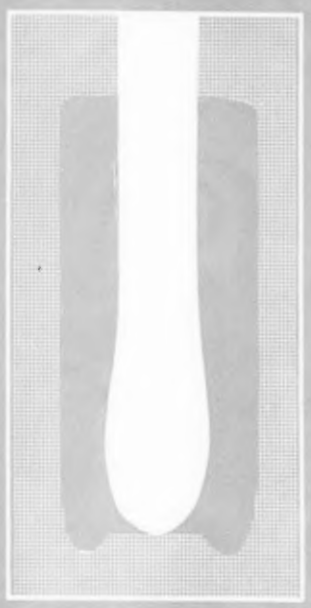
FEBRUARY 1961

THE MAGAZINE OF APPLIED ENGINEERING

TECHNOLOGY

BLOW PATTERN - CYLINDRICAL SHAPE

"Champagne" Bottom



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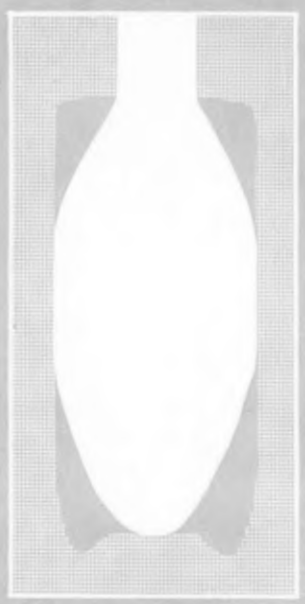
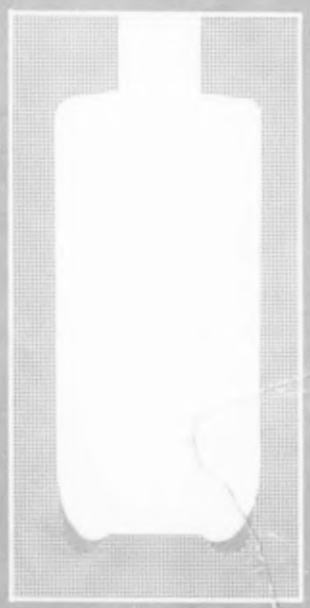


3/8 Blow Time



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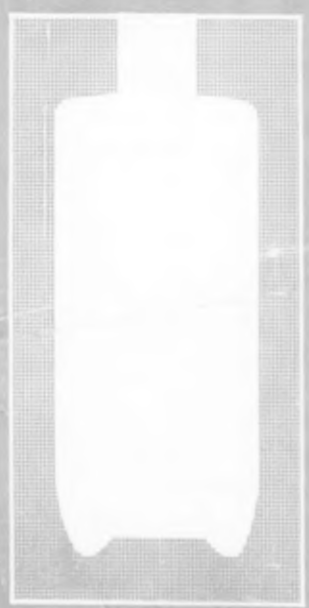

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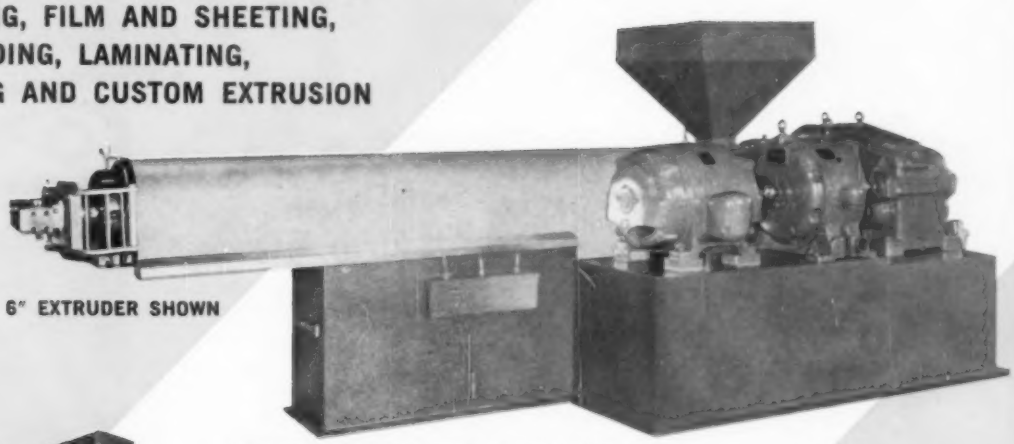

6" EXTRUDER SHOWN

Sterling's high speed and high production extruder pictured here incorporates new reducer, new thrust bearing assembly and new lubricating system allowing for higher horsepower input, higher thrust bearing capacity, higher screw speeds and therefore higher production. All Sterling's extruders are now built with these new components. Sizes from 1½"-12" with L/D ratios of 21:1, 24:1 and 30:1.

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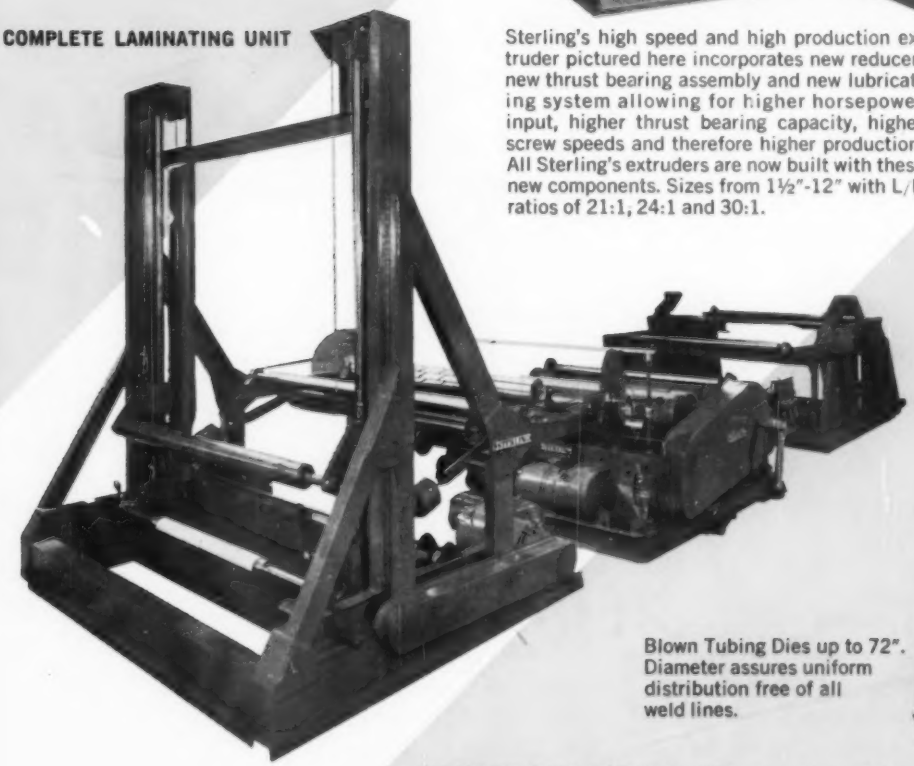

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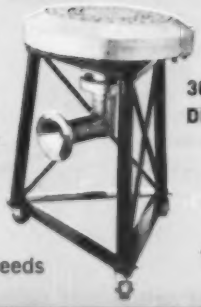

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THE MAGAZINE OF APPLIED ENGINEERING

TECHNOLOGY

February 1961, Vol. 7, No. 2

feature articles:

viscometric measurement of plastisol fusion ..... p. 35
by J. A. GREENHOE
This proposed test measures plastisol consistency from a dispersed state to total solvation. It complements the earlier described (Oct. 1960) Hot-bench fusion test.

drying polyethylene sheathing compound prior to extrusion ..... p. 40
by F. H. KRUGER
Carbon black-filled polyethylene is subject to water adsorption which, in turn, causes blistering on extrusion. Conditions for drying the material and the maximum allowable moisture content are determined.

infrared analysis and epoxy formulation ..... p. 47
by DR. HENRY L. LEE
The spectrophotometer is described—its operations and its application to the plastics industry. Since it gives a complete chemical picture, it can be used to "tailor-make" compounds.

bench molding with lightweight molds ..... p. 50
by C. L. CARLSON and E. M. HALLUSKA
Aluminum alloys are given a special treatment so that they can be used for molds. The process is known as hard coating or hard anodizing, tradenamed the Martin or the Aluminite.

guest editorial:

will the plastics of today be around tomorrow! ..... p. 45
by J. L. ROGERS
Product research and development.

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by HARRY T. DOUGLAS
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E. I. du Pont de Nemours and Company

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Letters to the Editor

More on flexible foams

Sirs:

The article, "Markets for Flexible Foam," by P. B. Nortman in your December issue, is a very comprehensive review of this growing market and will be very helpful to us.

We would also appreciate it very much if you could feature an article on "Markets for Rigid Foams" in the not too distant future.

T. H. Evans
Naugatuc Chemicals Division
Dominion Rubber Co., Ltd.

Sirs:

Your discussion of urethane foam markets was very interesting. Although I myself do not make urethane foams, I have had occasion to buy some for use in contemporary furniture, both chairs and slab couches which can also be used for beds.

For this type of furniture, which could be classified as low and middle priced, slab stock is ideal. Inasmuch as the furniture is rectangular, with sharp edges, the urethane is economical.

However, I am eager to hear of any developments in the area of foaming urethane in closed molds. Unless we use foam rubber, which raises the final price of the items, we are rather limited in design. I am sure that as soon as urethanes can be foamed to shape, there will be a large increase in their consumption by furniture makers. This is, to me, the only serious disadvantage urethane foams have in this market.

William B. Wallace
Foam Designs, Inc.

•

Recommended reading

Sirs:

I am at present designing machinery used in the textile industry. I have recently had occasion to read your magazine, PLASTICS TECHNOLOGY, and have developed an academic interest in the plastics field, particularly in the types of machinery used—extruders, injection molders, blow molders, etc.

I was wondering if you would possibly have available within your organization a listing of text books or other literature, through which I might acquire more knowledge of plastics machinery and the related processes. Such information would be greatly appreciated.

Stephen S. Gagham
Van Vlaanderen Machine Co.

(Reference volumes and text books covering the whole plastics industry and segments are available. Some are written for the technically-trained person, while others can be understood by the layman or beginning student. Because the industry is dynamic and young, books may become out of date quickly. Trade journals, therefore, are an excellent source of information.—Ed.)

•

Expansion into plastics

Sirs:

We are in the concrete pipe manufacturing business. We feel that possibly with the rapid advancements in the plastics industry, there might be uses in our industry for them.

I have not been able to find any information locally that indicates this may be so, and wondered if you might direct me to a source of information.

R. T. Hawkins.
W. T. Liston Co.

(This company is not the first in concrete pipe manufacture to become interested in plastics. On the contrary, there seems to be a trend for pipe makers of all sorts to wish to explore the possibilities of working with plastics.

Any manufacturer can find the sort of information Mr. Hawkins seeks by contacting the Society of the Plastics Industry. The material most closely related to the concrete pipe manufacturing field is reinforced plastics.—Ed.)

•

We invite letters from our readers for publication in these columns. Such letters may be of comment or criticism, requests for information, or of general interest. The only requirement is that all letters must be fully identified as to name of sender, company affiliation and address.

A letter will not be printed if publication is not desired by the sender, and the identity of the writer will be withheld, if desired.

—The Editor

On schedule

Epoxy plasticizer performance. E. W. Lines, New Chemicals Department, Union Carbide Chemicals Co., New York, N. Y.

Four epoxy plasticizer-stabilizer compounds are evaluated in vinyl films and plastisols. Considerable data is given on viscosity stability, compatibility, and performance under varying conditions and concentrations. Stabilizing levels run 5-10 PHR, while plasticizing levels vary from 15 to 60 PHR. Metal stabilizers are said to have a synergistic stabilizing action with epoxy, and make possible the production of clear films.

•

Low/No pressure fabrication of silicone laminates. D. T. Retford, M. E. Nelson, and K. R. Hoffman, Product Engineering Laboratories, Dow Corning Corp., Midland, Mich.

Two laminating resins are described along with methods of layup, molding, and cure. Test values reported are based on fabrication by vacuum bag molding and casting with contact pressure. Physical and electrical properties of the laminates are covered.

•

Wollastonite—an extender for polystyrene. Peter Virtue, Cabot Corp., Boston, Mass.

Wollastonite (calcium metasilicate) can be used as a filler-extender pigment for polystyrene, though not the high-impact materials in amounts sufficient to give substantial savings. Ordinarily, pigment incorporation in polystyrene in excess of 3% by weight causes a significant degradation of physical properties, tensile, elongation, and modulus. Several tables are included.

•

Abrasion and wear resistance of reinforced plastic surfaces. C. B. Sias, Director of Plastics Technical Service, Pittsburgh Plate Glass Co., Springdale, Pa.

Melamine, epoxy, and allyl resin surfaces can be expected to give better abrasion resistance than styrene-thinned polyester resins. NEMA values were run on the vertical fiber series which showed very high abrasion in the control. Horizontal fibers improved the wearing surface.

•

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Specifying D-M-E Standard Mold Bases and component parts reduces mold cost, saves time, and provides an unlimited variety of plastic mold assemblies.

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Whether for injection or compression molding, D-M-E Standard Mold Bases enable you to work with greater flexibility by providing a selection of over 7,000 cataloged mold base combinations! And D-M-E Master Layouts enable designers to devote more time to cavity layout.

MOLD MAKER: D-M-E first-quality carbon or alloy steel assures easier and more reliable machining. And D-M-E Standard Mold Bases have exclusive built-in features at standard cost: surfaces ground flat and square; patented tubular dowels; one-piece ejector housing; stop pins welded to ejector plate; 33 sizes from 9⅞" x 8" to 23¾" x 35½".

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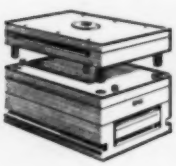

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U.S.I. POLYETHYLENE NEWS

A series of advertisements for plastics and packaging executives by the makers of PETROTHENE® polyethylene resins

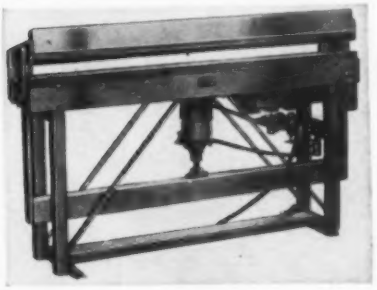
FEBRUARY, 1961 — U. S. Industrial Chemicals Co., Division of National Distillers and Chemical Corporation — 99 Park Ave., N. Y. 16, N. Y.

Packaging Notes

High-speed bottle blowing machine available from a Danish firm produces 5,000 finished bottles per hour, according to a recent announcement. Fully automatic, it operates with 1 to 5 molds, can work on 11 different cycles, has 3 interchangeable tables (up to ½, 2½ and 5 gallons).

Squeezable ink bottle blow-molded of conventional polyethylene permits tidier filling of fountain pens. Pressing the sides of the bottle draws ink into a special well from which pen is easily filled.

Extra-length heat sealer designed for use with thin polyethylene films makes seals up to 96" long. The latest of a series of heavy-duty, all-steel thermal units available from a New York company, it operates by foot switch and has a pneumatic safety system. Can be adapted with built-in "recycler" for automatic operation and completely controlled integral compressed air supply.



Polyethylene filling cover for drums and tanks has cavity to catch dangerous and costly spillage. It has built-in handles, expandable fill pipe opening and molded pouring lip. And, according to the producer, is chemical resistant, lightweight and unbreakable.

New moisture-tight bags, designed for highly hygroscopic products, are constructed of strong white paper laminated to aluminum foil with polyethylene coating on the foil side. All seams are heat-sealed, as is the top after filling.

A California company chose these bags over cans of comparable capacity for its instant apple sauce. Extensive testing showed they resist moisture and retain vitamins; cost 48% less than cans, take 23% less space and weigh 10% less. The product is being packaged semi-automatically in 19 oz. and 7-lb. bags flexographically-printed in red, green and yellow.

Polyethylene Mulch Film Permits Early Crop Set and Harvest . . . Ups Marketable Yields

Increases Test Yields of Vegetables As Much As 100%

Recent tests at the Oregon State College Agricultural Experiment Station, Corvallis, and the South Dakota State College Agricultural Experiment Station, Brookings, have proved that polyethylene mulch film more than justifies its cost.

See the difference polyethylene mulch film can make? The plant at left was grown with film, the one at right without. Note healthier look, greater yield.

Findings were cited by James P. Menn, staff agronomist of the U.S. Industrial Chemicals Co., at the 73rd Annual Meeting of the Florida Horticultural Society.

Mr. Menn noted that the Oregon State College tests on tomatoes resulted in a marketable yield of over 20 tons per acre with polyethylene mulch, 10 tons per acre without. Marketable pole bean and cantaloupe yields also were considerably greater when the mulch was used. At South Dakota State College, too, significant yield increases were reported for sweet corn, snap beans, carrots, cabbage, and cucumbers.

Available commercially in durable, flexible, lightweight black film, polyethylene mulch provides special protection because of its high impermeability to water vapor and gases. Its physical properties can be varied to raise or lower soil temperatures, conserve soil moisture and control weeds and plant diseases. Consequently, it often results in early crop set and harvest as well as increased marketable yields.

The U.S.I. agronomist pointed out that some 33 land grant colleges are now carrying on, or have recently completed, research projects on polyethylene and other plastic mulch materials.

New Connector For Polyethylene Tubing

A new kind of fitting, claimed to connect small-diameter polyethylene tubing simply and economically in just two seconds, has been introduced. According to the manufacturer, the new connector will open up possibilities of replacing metal tubing with lower-cost polyethylene tubing in electrical appliances, automotive equipment and other industrial applications.

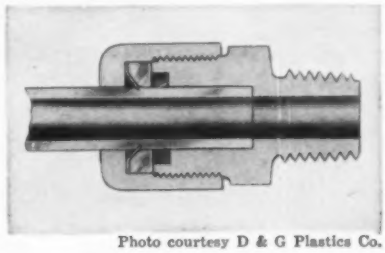


Photo courtesy D & G Plastics Co.

The fitting is an O.D. type, so there is no restriction to flow. Connection is made by merely inserting tube into the fitting with a twisting motion as far as it will go. Result is a positive seal—leakproof for vacuum, gases and fluids over a wide range of temperatures and pressures.

Connectors are guaranteed by the manufacturer to meet all requirements governing the transmission of fluids for human consumption. Available for use with standard tubing ¼", ⅜", ½" and ⅝"—either male or female threads.

Oil-Resistant Ink System For Polyethylene Film

Shredded coconut and other products high in vegetable oils can now be packaged in polyethylene film printed in as many as five colors. A new oil-resistant ink system, sold at no extra charge over regular ink systems, has been successfully tested on thousands of bags, its developer reports.

Previous ink formulations used on such oily products would soften or rub-off on nearby packages or customers' hands. Destructive tests on the new inks have shown no deterioration and have proved out shelf life and oil resistance. Special printing plates used are compatible with the inks.

DO YOU HAVE a new polyethylene product or development you'd like the industry to know about? Make it routine to send your information on new developments to U.S.I. POLYETHYLENE NEWS.

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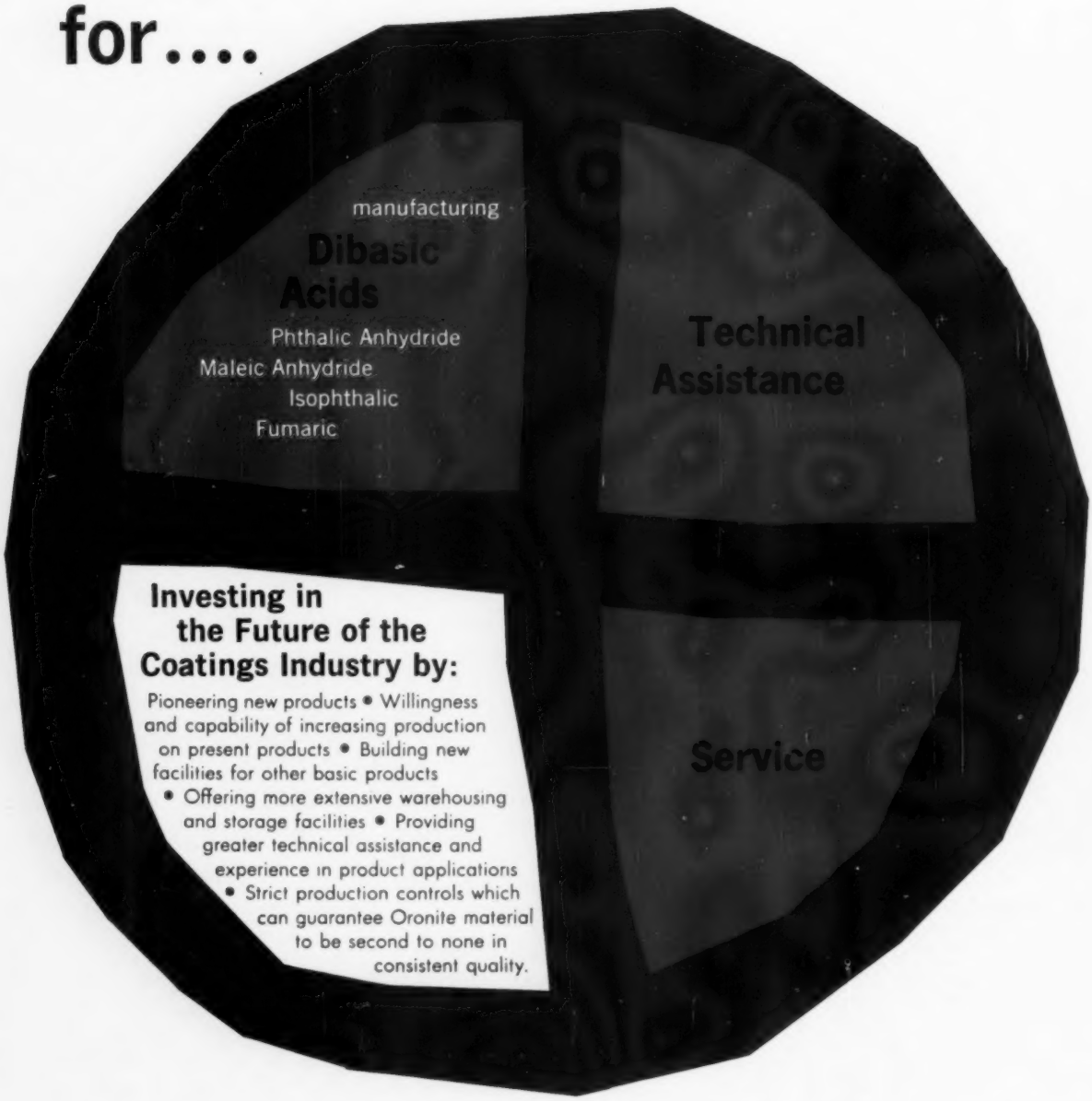
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Take an existing product made with a common material, redesign and produce it with Lustran, and you will create a new product made with fewer pieces, little or no finishing, less labor, and at far lower cost than previously thought possible. You will have a product with an amazing combination of light weight, unusual toughness and durability. And it will have the sales appeal to help you increase volume—profitably.

Take that development product that's on the drawing board or the one that hasn't quite gelled in your mind . . . Lustran is the material to make these ideas come alive and earn profits. Or perhaps Lustran is the material needed to spark that elusive new product idea.

What is Lustran? Lustran is a unique composition of styrene and other monomeric materials produced by using an entirely new concept of molecular arrangement. It employs an advanced polymerization technique to meet the higher requirements of more applications more efficiently than ever before. Whether your product requires components that run two hundred to the pound or ten pounds each, Lustran is the material for rugged performance and profit improvement.

What are its properties? Lustran is so versatile that it can be formulated to meet a broad range of physical, chemical and price requirements. Lustran has a unique combination of effective strength, rigidity, and other desirable properties to a significantly high degree. One Lustran formulation, for example, has 4 times the impact resistance of rubber modified styrene, 10 times that of general purpose styrene. Lustran has exceptional impact and tensile strength, a vast color range, rigidity, abrasion and chemical resistance as well as efficient, economical processability. Products made with Lustran have excellent surface appearance, hardness and gloss. You can drive nails or turn screws into Lustran. At zero degrees Fahrenheit, a $\frac{1}{8}$ inch thick 24 inch square sheet withstands the shock of 25 foot pounds. Under an 800 pound load, an automotive armrest made of Lustran remains intact while the supporting metal screws fail.

What are the uses for Lustran? Lustran has been successfully injection molded into parts weighing as much as $3\frac{1}{2}$ pounds and vacuum formed in deep drawn parts weighing up to 11 pounds. It will find great demand in products which require high impact strength, rigidity, and breakage resistance in addition to the traditional important advantages of plastics . . . built-in color, corrosion resistance, single-piece construction. Lustran promises new developments in design and cost savings for new products, components and housings for business machines, automobiles, refrigerators, air conditioners, fans, radios, television, vacuum cleaners and other appliances, housewares, shoes, packages, pipe fittings and toys. Wherever performance and cost are critical, Lustran will find application.

What are its processing characteristics? Plastics converters who have worked with Lustran have been astonished at the superior thermal stability of Lustran. Over a wide range of temperatures, it is possible to produce components with excellent uniformity in color and physical properties . . . performance not always achieved with other styrene polymers. With Lustran you can achieve consistent color control even in softest pastels. It can be molded and extruded in standard equipment. Sheets of Lustran can be formed, fabricated, and decorated using conventional techniques.

Can you capitalize on this development now? Lustran is now available from interim production facilities which can meet anticipated commercial requirements. A fifty million pound plant is now under construction. It will be in operation the latter part of 1961. With the addition of the Lustran family of plastics to our familiar Lustrex styrene molding materials, Monsanto now supplies the broadest spectrum of styrene based materials.

An extensive program has been set up to acquaint plastics converters with the unique capabilities and business building opportunities of Lustran. Plastics converters are invited to contact the nearest Monsanto sales office for more information. Designers and manufacturers are invited to write for current data and progress reports to Monsanto Chemical Company, Plastics Division, Dept. 803, Springfield 2, Massachusetts.

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What's new in processing

An extremely simple method of pin point gating in injection molding has been developed by the Seymour-Ross Corp. The system depends upon an internally-operated valve which is retracted by the pressure of the material as it flows into the cavity. The process can be used with single or multicavity molds, and is adaptable for all thermoplastics.

Molten resin is precompressed in the internal manifold, where it surrounds the valve plunger. Because pressure will equalize itself, full pressure on the ram is carried by the molten resin to the valve plunger. The plunger is retracted, compressing the 50-pound spring, by the pressure of the material on the valve shoulder; and the gate opens. Material shoots into the cavity. After curing, the ram retracts, releasing the pressure and allowing the spring to close the valve plunger against the gate. Extremely small heaters at the valve prevent freezing.

The Seymour-Ross process is best suited for molding small parts or products. Rapid filling and gate sealing are the major contributions toward estimated production increases of 20-50%. Greater plasticizing capacity of the internal manifold also increases the amount of molten plastic available at a single time. Time is saved by the short start-up, and full production is claimed to begin as soon as the main cylinder and valves have heated to the proper temperatures.

Abstracts

"Vacuum Forming" by T. Rice, Applied Plastics, December 1960, reviews different techniques for vacuum forming and gives some practical hints for working with plastics for economy and quality. For economy, placing molds closely, using automatic machines, and user-extruding of material for forming are recommended.

"How to Encapsulate with Alkyds" by J. J. Moylan and J. T. Long, Applied Plastics, December 1960, discusses current molding practices for encapsulating electrical and electronic components with alkyd putty and granules.

Patents

2,898,632 to Dayton Formold, Inc., Dayton, O. A method of molding foam articles with a glazed surface. Walls of the mold are heated just enough to melt the outer surface of the article. At the same time the beads are expanded by steam.

2,898,634 to Sterling Alderfer Co., Akron, O. A process for producing a foam within a flexible casing.

2,899,710 to Tube Turns Plastics, Inc. A process for molding polytetrafluoroethylene in which pellets are first heated to over 580° F., then transferred into mold cavity for compression and more heat.

2,899,708 to Dow Chemical Co. A method for modifying and controlling the density of a rigid thermoplastic foam.

2,899,709 to Societe Plastus S.A., Fribourg, Switzerland. In a process of making hollow bodies from plastic materials, gas is blown into an extruded plastic tube through the open end. This is accomplished within a mold that simultaneously forms the outside of the object.

2,905,972 to Monsanto Chemical Co. A method for preparing foamed thermoplastic resins forms. Foamable resin is extruded into a forming die at temperature high enough to expand resin beyond limits of die. Temperature is dropped around contact surfaces of die to produce smooth surfaces.

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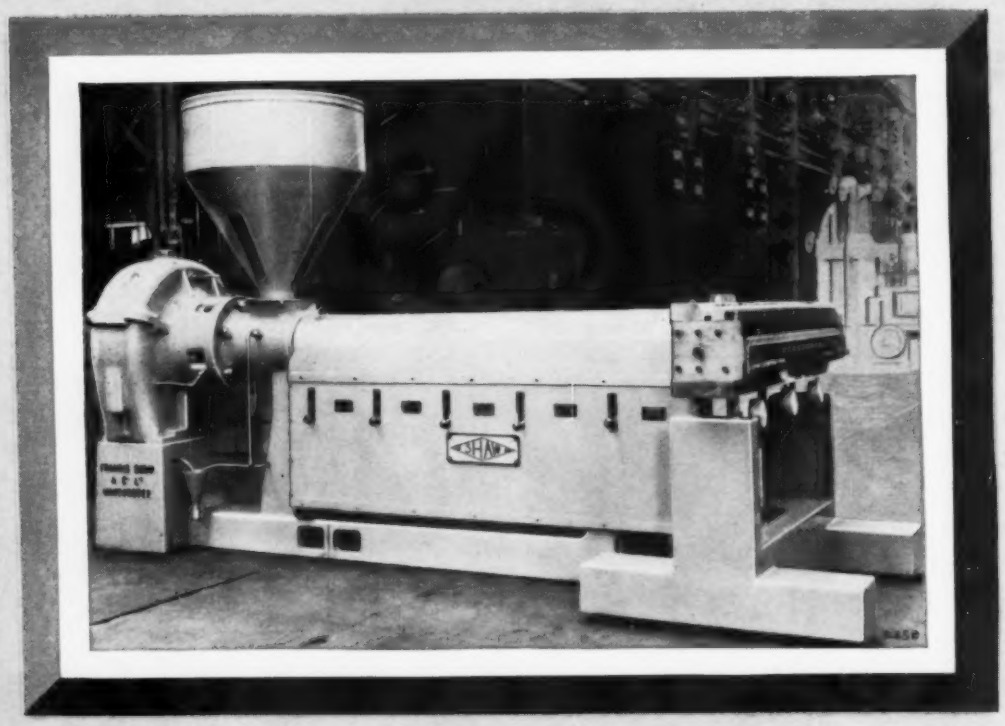

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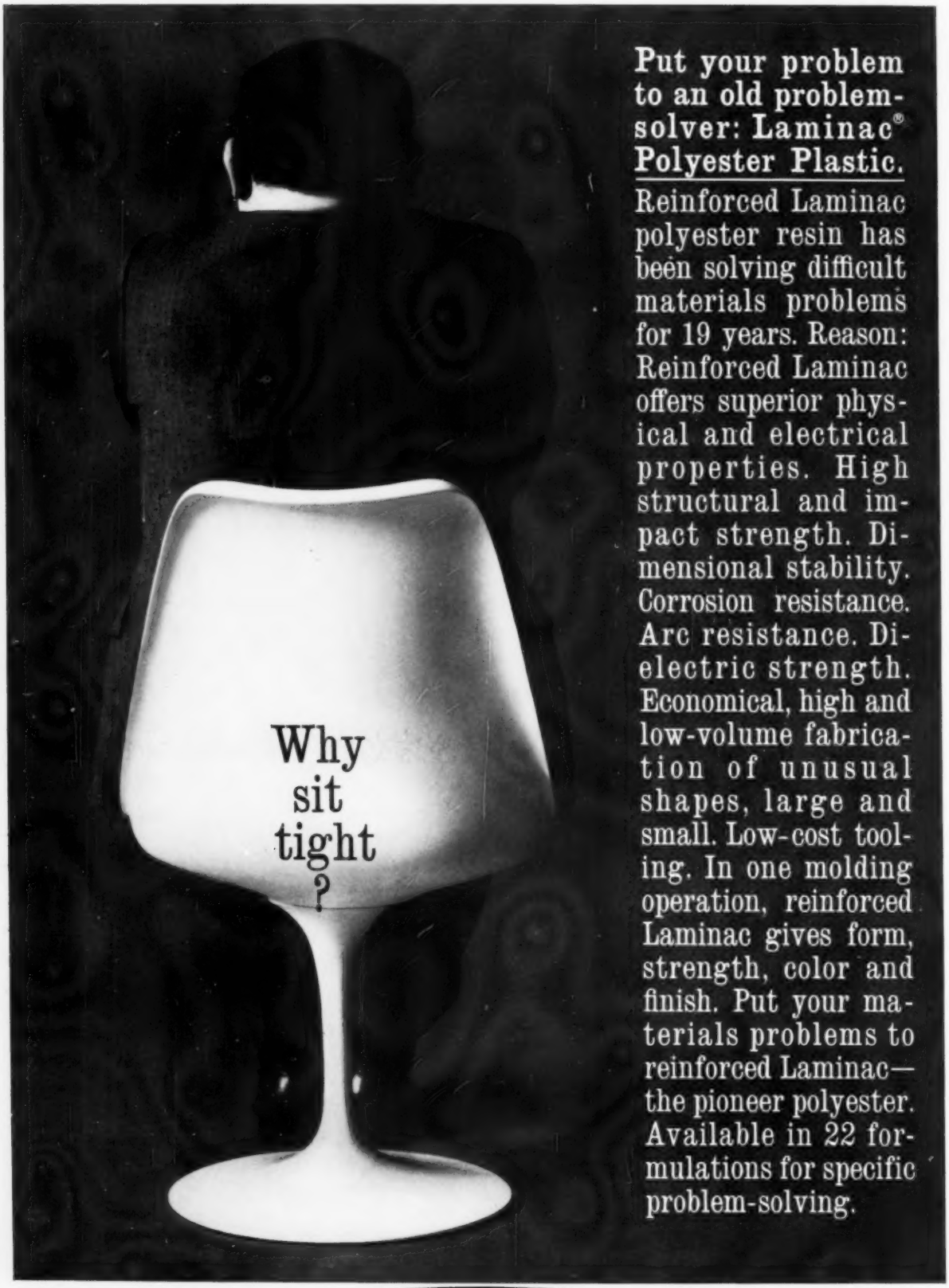

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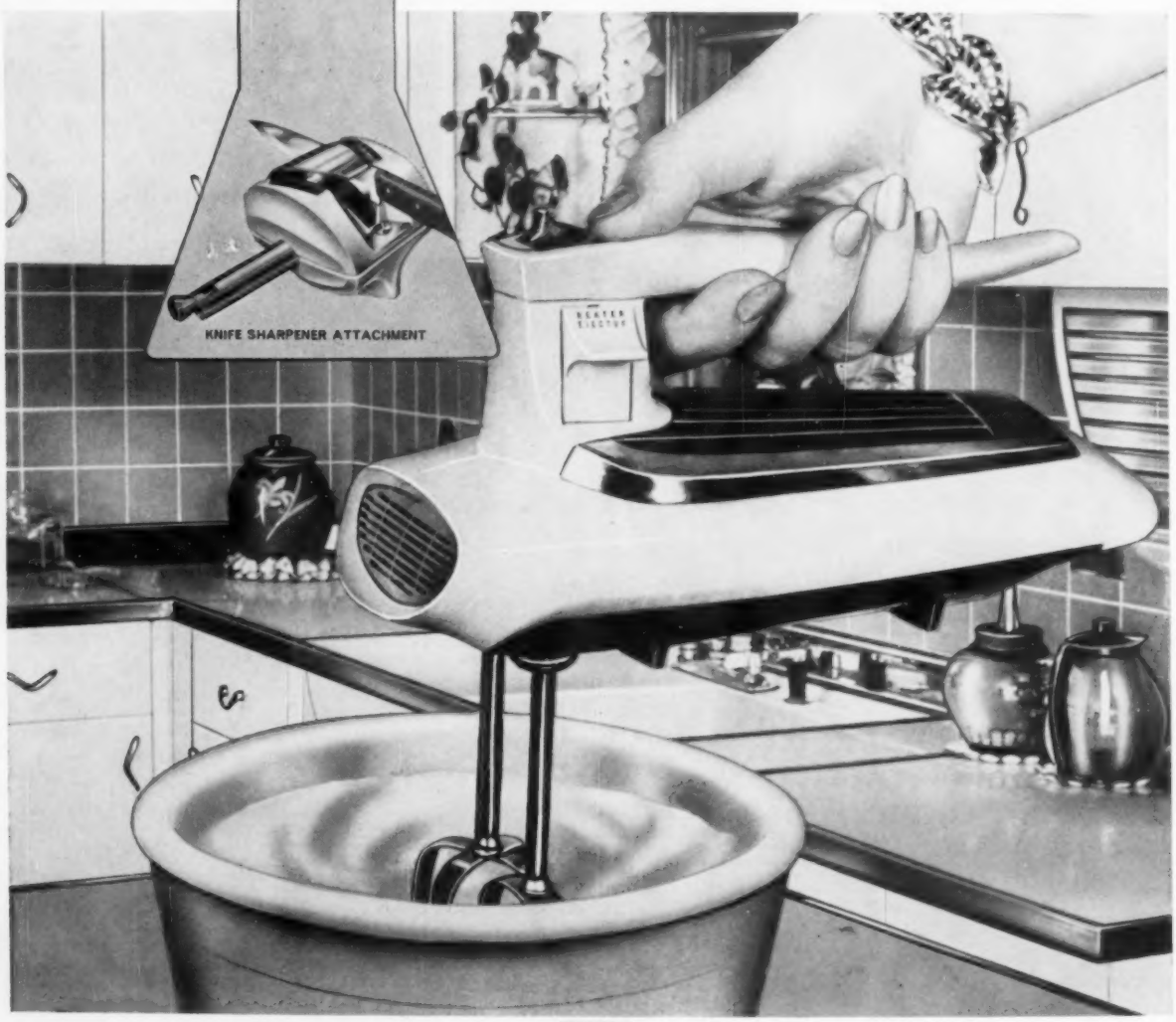

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Take advantage of the outstanding properties that these *basic lead* stabilizers will give your rigid pipe, sheet or structurals. You'll be pleased with the product uniformity you get with National Lead's quality-controlled stabilizers. You'll like the constant single-phase lubrication of DS-207. And you can forget dry blend or odor problems in production!

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M-2

Editorial: The plastics institute—an accomplished fact

On January 25, the Plastics Institute committee decided to proceed with formal incorporation of the Plastic Institute of America as a non-profit organization. Industry-wide support has been assured.

Newly-elected chairman is Jules W. Lindau III, president of Southern Plastics Co. He succeeds Professor Louis F. Rahm, chairman of the committee for the past year. Dr. Rahm outlined the reason for establishing such an institute in our September, 1960, issue.

The Institute will be concerned both with helping solve technical problems for the plastics industry and assuring its future growth. It will fill the need for basic research into the properties of materials, disseminating its findings to all levels of production, processing, and end-use.

Education—at the graduate level—will also come within the Institute's bailiwick. To this end, it will affiliate with a leading educational institution, yet to be selected. Already approved is an initial research program, prepared by Jerome L. Formo, a former chairman of the committee. This program will be presented to industry within the next few months as part of a membership-solicitation campaign.

Our Guest Editorial this month points up the value of applied research. We could not be more in agreement, but we feel compelled to support basic research a little more strongly—especially in the areas of unbiased standardization. Many test methods are still not accepted as standards—even for physical properties of the base materials.

The plastics processor just cannot afford, individually, the cost of a research program aimed at establishing standards and tolerances. It cannot educate its customers as to what are realistic and acceptable tolerances for plastics. The Institute is in a position to fill a badly needed void.

Conscientiously worked out, and given the support it deserves, the Institute should make substantial contributions to the effectiveness and prestige of the plastics industry. We wish it every success.

•

Effective March 7, DuPont lowers the price of Delrin acetal resin to 65¢/lb. in carload lots. Expect a tremendous jump in consumption of this plastic, which has already replaced brass, zinc, and steel in many applications. Also of extreme interest, its price goes below nylon for the first time (even allowing for differences in specific gravity). Differences in shrinkage factors will probably prevent changeover on existing molds; however, new applications are an entirely different matter. It seems a safe bet that the price of nylon molding powder will go down accordingly. Whatever the final result, either or both of these materials should take over some of the markets previously held by metals and rubber.

Jim Dugan

Editor

Oil-resistant ruggedness for heavy-duty vinyls

The prime requirement in vinyls for really demanding service—plasticizer permanence—is supplied in the fullest possible measure by Rohm & Haas PARAPLEX® G-54 polymeric plasticizer. In addition, it offers good processing characteristics.

Vinyl compounds plasticized with PARAPLEX G-54 show excellent resistance to extraction by grease, oils, solvents and soaps. Among other properties desirable in heavy-duty applications are: good resistance to heat, good resiliency and low-temperature flexibility, very low volatility, and negligible tendency to migrate into paints and plastics. As a result of an improvement in manufacturing procedure, PARAPLEX G-54 is very light in color—hence well suited for clear, white, or pastel compounds. The improved process also affords a further reduction in odor level.

For electrical compounds, PARAPLEX G-54 possesses the resistance to volatilization and degradation by heat and light essential for maintaining flexibility and tensile characteristics on prolonged aging at elevated temperatures.

Whether you make vinyls for truck upholstery, electrical insulation, gaskets, baby pants, or any other similarly demanding purpose, PARAPLEX G-54 offers you important advantages. Write today for complete technical information on this versatile plasticizer and other polyester and monomeric plasticizers developed by Rohm & Haas.

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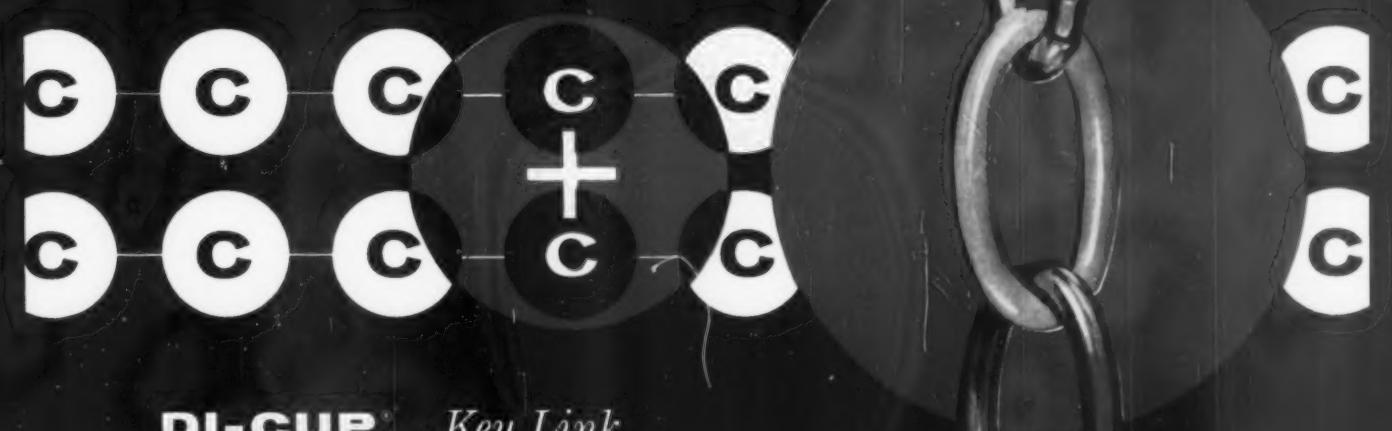
PARAPLEX G-54



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Di-cup, Hercules dicumyl peroxide, is a source of free radicals, which are highly effective in chemical cross-linking. It provides a simple, economical, and practical means of cross-linking low-density polyethylene.

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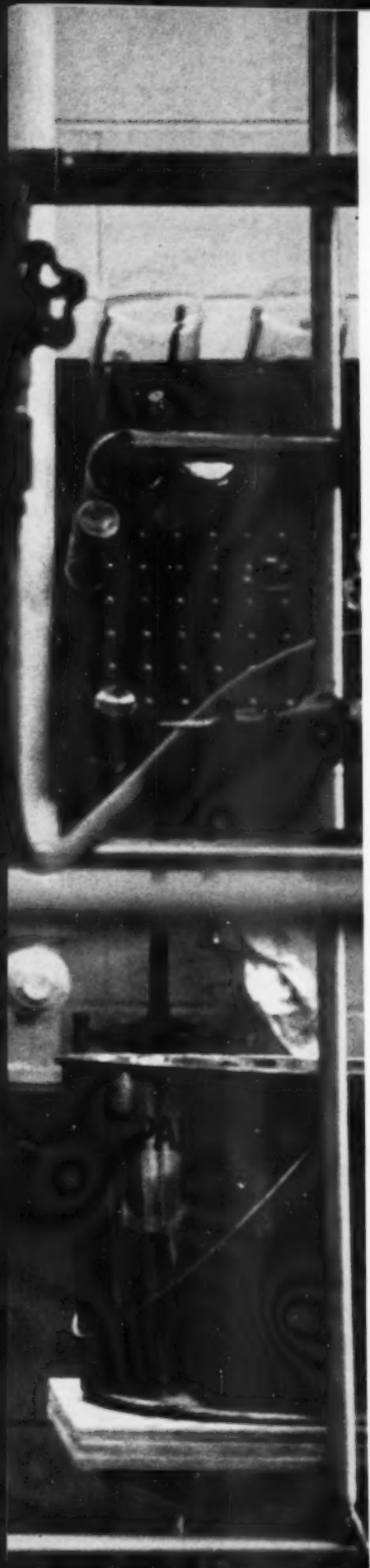

Joe Foster considers the scope of
Foster Grant's research and development.

"Stereospecific polymerization catalysts may trigger a materials revolution," says Joe Foster

That's what my research and development group tells me. And, we've been giving this area top priority, along with polyamide polymers and co-polymers and graft polymerization.

We know that only through persistent evaluation and re-evaluation can improved resins such as today's general-purpose polystyrene, impact-polystyrene and nylon-6 result. These are the popular-priced plastics that help you produce more efficient, more profitable end-products.

Because we're the world's largest manufacturer of sunglasses, as well as a raw material supplier, we also know that research and development is only part of the answer. During the past 41 years, our combination of raw material and end-product know-how has made us familiar with bulk handling, color matching, machine and mold design—just about every molding problem you're likely to meet.

When you mold with Foster Grant resins, the benefits of this lifetime of successful plastics experience are yours to draw on. Let us show you how we can apply this background to *your* molding operation. Call or write me today at Foster Grant Co., Inc., Leominster, Mass., KEystone 4-6511.

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Is there any field where design is more important for sales than in toymaking? Small wonder that so many new examples of advanced design involve products blow-molded from BAKELITE Brand high-density polyethylene.

In production and performance, this combination of product and process yields superior results—toys that are tough, durable, light in weight, richly colored. And with blow-molding, they are produced economically and quickly. Large or small, simple or complex, scores of other things are being profitably blow-molded of BAKELITE Brand polyethylene.

Union Carbide gives you a choice of polyethylenes for blow-molding —low, medium, or high density. At one authoritative source, you can expect simplified selection of the best material for your needs. And you can get expert advice in arriving at your decision.

This also includes technical aid in blow-molding your products to best advantage. Union Carbide's experience in blow-molding dates back almost as far as the technique itself. For information, write Dept. JS-105B, Union Carbide Plastics Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, N. Y. *In Canada*, Union Carbide Canada Limited, Toronto 12.

Body and legs of Madame Alexander 36″ nurse doll (A) and 15″ Cathy doll (B) blow-molded of Bakelite Brand high density polyethylene for Alexander Dolls, Inc., New York, N. Y. Ring (C) and bead (D) sets and wheels for toy racer (E) blow-molded of high density polyethylene by Fisher-Price Toys, Inc., East Aurora, N. Y.

UNION CARBIDE

BAKELITE and UNION CARBIDE are registered trade marks of Union Carbide Corporation.

New RCI Epoxy Casts Under Vacuum Without Foam-out

Typical casting made with ordinary, low-viscosity epoxy containing volatile diluents that foam out at room temperature under vacuum.

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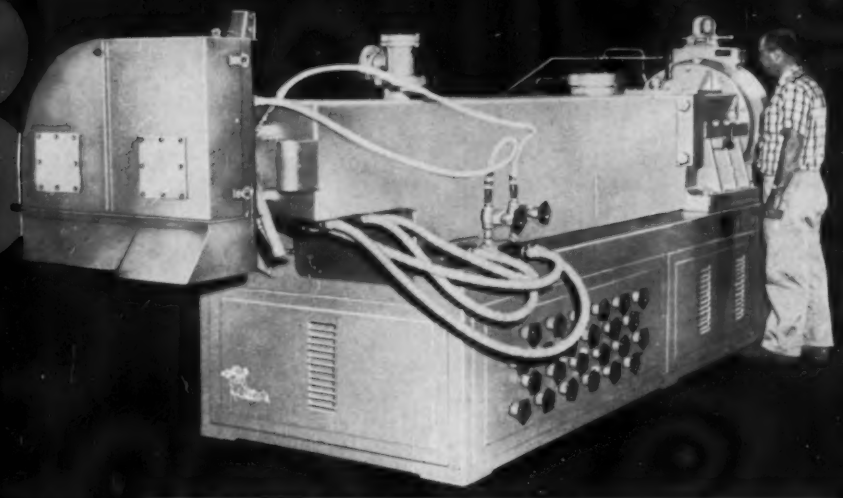

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PLASTICS
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TECHNOLOGY

Viscometric measurement of plastisol fusion

For many years, both ASTM and SPI have been seeking uniform test methods. Viscosity data on plastisols have been practically impossible to correlate; however, Mr. Greenhoe is describing a test, the Fusion Viscosity Test, which does correlate with a test he described in our October, 1960, issue—the Hotbench Fusion Test. Here, he offers a means for observing plastisol consistency from a dispersed state to total solvation.—Editor.

J. A. GREENHOE*

Heat applied to a plastisol converts the fluid dispersion of vinyl resin in plasticizer to a solution of resin in plasticizer. In this solvated state, the plastisol is said to be fused. The time and temperature necessary for this conversion have already been studied from physical measurements made upon fused plastisol specimens prepared under various conditions. Such studies, though of positive value, offer little insight into the actual mechanism of fusion, or into the intermediate states of the plastisol before fusion.

Test methods

Gelation studies have been made (1)** by measuring the viscosity of the resin and plasticizer dispersion while it is being heated. In this way, observations are made continuously of the beginnings of resin solvation up to the plastisol's gelled state. Such tests offer the advantage of observing the change of state as it occurs.

The Fusion Viscosity Test—the subject of this paper—provides a means of measuring plastisol fusion continuously while it is taking place. In contrast to other methods of measuring plastisol fusion, this test offers a means of observing plastisol consistency from dispersed state to total solvation. Results will be compared with those determined by the Hotbench Fusion Test (2) and with tensile strength measurements of fused films prepared at various fusing temperatures.

* Tech. Service Rep., Opalon PVC, Monsanto Chemical Co., Plastics Division, Springfield, Mass.
** Numbers in parentheses refer to Bibliography at end of article.

Fusion Viscosity Test equipment is the same as that used in measuring plastisol gelation. Equipment consists of a HAT Brookfield Viscometer, adapted to hold a metal tube in which the No. 7 spindle of the viscometer is centered. The tube is stoppered at the bottom end and a thermocouple is inserted through the stopper, centered one-eighth inch below the viscometer spindle.

The F-V test differs from the gelation tests in two respects: the plastisol to be tested is not a practical formula, but a test formula containing a very low concentration of resin in plasticizer; and the temperature to which the plastisol is heated is higher. The low-resin-concentration plastisol is put in the sample tube, the viscometer spindle is centered in the plastisol, and the sample tube is immersed in a constant temperature (352° F.) oil bath. The viscosity is read and recorded at 30 second intervals while the viscometer is allowed to run continuously at 10 rpm. The plastisol temperature, at a point near the viscometer spindle, is recorded automatically. Apparatus used is shown in Fig. 1.

Fig. 2 shows a typical curve obtained when the viscosity and temperature are plotted against a common time scale. The viscosity curve is a record only of the plastisol's fusion stage and does not represent the rise in viscosity associated with resin gelation. Because of the low resin content, the rising viscosity during gelation is of an order too low to be measured by the Brookfield speed, spindle, and spring constant which have been chosen to measure Fusion Viscosity.

In Figure 2, at the first recorded viscosity rise, the

resin has been swollen by plasticizer and gelled resin particles adhere to each other. The height of the viscosity curve represents the greatest cohesion between gelled, solvated particles. The viscosity drop after maximum viscosity is reached reflects the disintegration of solvated resin gel particles and a conversion to a homogeneous solution of PVC in plasticizer.

At temperatures above a maximum Fusion Viscosity, the viscosity drops with temperature and time to an equilibrium viscosity of low value. This final figure is the viscosity of solvated resin in plasticizer and is related both to the molecular weight of the resin and to the molecular weight and structure of the plasticizer. Table 1 illustrates the relationship between resin molecular weight and the equilibrium viscosity of several resins at 350° F.

Table 1. Equilibrium Fusion Viscosity at 350° F. and Specific Viscosity of Various Commercial Paste Resins.

Resin	Fusion Viscosity	Specific Viscosity
A	1900	.714
B	1750	.610
C	1040	.601
D	800	.555
E	500	.534
F	64	.506

Only when the viscosity reaches this equilibrium value does the solution appear to be truly homogeneous in the sense of containing no residual ordering of resin particles or molecules.

Fig. 2 also shows a fluctuating slope in the temperature curve, the depression of which coincides in time with the greatest rate of viscosity rise of the fusing plastisol. This rapid rise can be attributed to rapid resin solvation. Since polyvinyl chloride has a negative heat of solution (3), or requires heat to solvate, the decreasing slope of the temperature curve is best explained as an indication of the heat being removed from the system to solvate the resin.

Another depression in the temperature curve of Figure 2 occurs at the point where the Fusion Viscosity curve begins to drop. This is interpreted as another area of fast resin solvation. The first depression probably represents the solvation of a large number of small-size resin particles, while the second indicates the solvation of a smaller number of larger resin particles. Although the secondary temperature drop may be caused by the heat required to melt the somewhat crystalline PVC, the so-called Heat of Fusion (4) would be so small as to be unnoticed in this test.

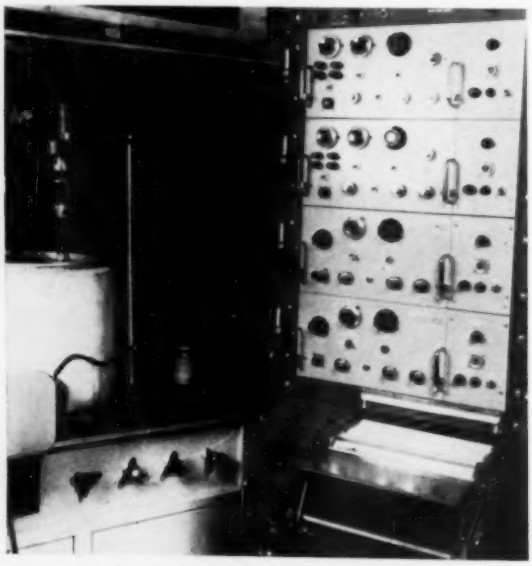

Fig. 1. Fusion viscosity test equipment.

J. A. Greenhoe

The Fusion Viscosity curve, then, depicts the effect of various qualities of a resin—principally, the particle size characteristics and molecular weight. It may also indicate molecular ordering of the resin. Walter (5) has developed data which can be extrapolated to show that the "melting point" of Vinylite VYNW plasticized with 300 PHR of DOP (resin volume concentration of 19%) would have a "melt" temperature of about 315° F. The similarity in "melt" temperatures indicates that the same phenomenon is being observed. Walter suggests that the amount of crystallinity in plasticized resin determines its "melt" temperature. In the case of plastisols, the "melt" occurs while the resin is being initially plasticized under heat with no mechanical working.

The plasticized resin forms small gel spots which disintegrate and form a homogeneous solution. The crystallinity or molecular "ordering" which occurs in a plastisol is within the resin particle where it was formed during polymerization. When plotted against temperature, the Fusion Viscosity assumes the shape illustrated in Fig. 3. Duplicate runs are shown in this figure to indicate typical reproducibility of the test. Great care is necessary in running a Fusion Viscosity to obtain a reproducible curve.

To make the Fusion Viscosity of low-resin-content dispersions meaningful, the test must be related to the fusion properties of typical resin-content plastisols. This problem is partially solved by the work represented in Fig. 4. Here, the temperature and Fusion Viscosity of a series of plastisols of varying resin concentration are compared in order to extrapolate the results to still higher resin concentrations. As the resin concentration is increased, the equivalent configurations of the parameter curves approach a constant temperature at which they occur. The dotted line which connects the maximum viscosities and the equilibrium solution viscosities

of this family of curves will each extrapolate to a temperature asymptote. These asymptotes are closely approached at relatively low resin concentrations. At the higher resin concentrations of practical plastisol compounds (resin volume concentrations of 0.5-0.65), the Fusion Viscosity curves can be predicted to change slope at essentially the same temperatures as the curves of dispersions of resin volume concentrations as low as 0.22.

Where studies are presented in the body of this work on 300 PHR of plasticizer (a volume concentration of 0.19 in the case of DOP), results must be interpreted since these results will fall 5-10° F. below results of tests made on plastisols of volume concentrations of 0.22 or higher.

Test results

To substantiate the practical significance of Fusion Viscosity, Fig. 5 compares it with the tensile strength development of a 60 PHR DOP plastisol at increasing temperatures. The tensile strength curve was developed from measurements on films prepared on a hotbench. The various Hotbench Fusion Points are also shown in this figure.

The Fusion Viscosity curve shows transitions which occur approximately at the Hotbench Fusion Points

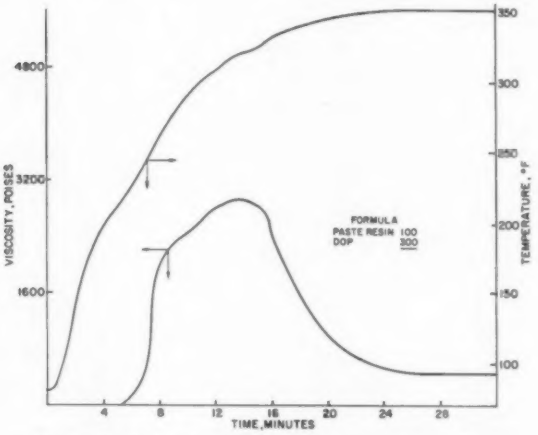

Fig. 2. Plastisol fusion viscosity and temperature vs. time.

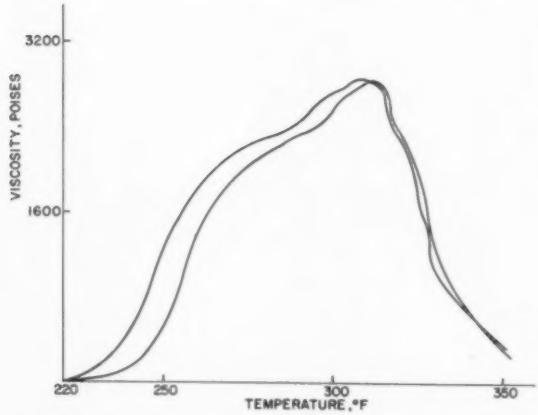

Fig. 3. Duplicate determination of the fusion viscosity vs. temperature on a 60 phr butyloctyl phthalate plastisol.

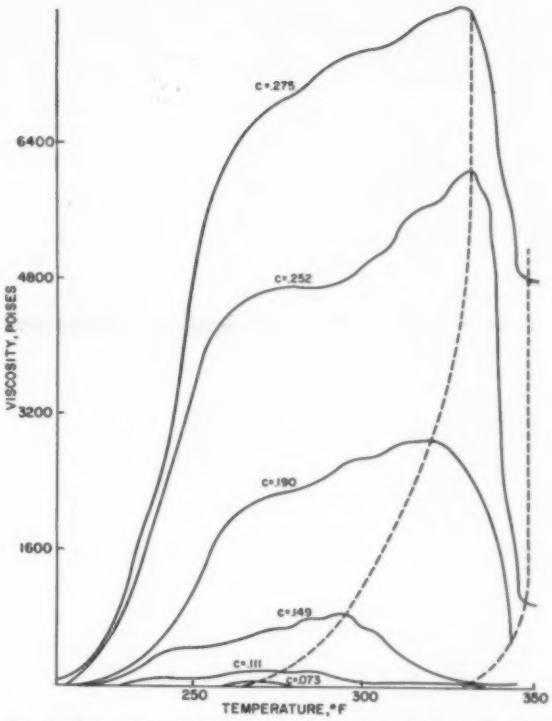

Fig. 4. Fusion viscosity at various volume concentrations of resin in dioctyl phthalate.

and at corresponding transitions in the slope of the tensile strength curve. Although the two curves were developed from plastisols differing greatly in resin volume concentrations, the coincidence in transition temperatures also demonstrates that the temperature at which various degrees of resin solvation occur are not seriously affected by resin volume concentration. This has also been shown in reference 2.

At 220° F., the resin particles are swollen by plasticizer and are sufficiently gelled to cause a measurable Fusion Viscosity. At approximately this temperature, the Hotbench "Gel Point" and the beginning of measurable tensile strength also occur. The Hotbench "Haze Point" at 250° F. occurs during an initial fast rise with respect to temperature in both Fusion Viscosity and Tensile strength development. The Hotbench "Elastomeric Point" (258° F.) occurs near the end of the initial rapid rise of Fusion Viscosity and tensile strength development.

Before complete fusion is indicated by tensile strength development, the Fusion Viscosity drops rapidly from its maximum value. The maximum viscosity marks a temperature at which a high degree of fusion but somewhat less than ultimate has been achieved.

At the Hotbench "Fusion Point" (347° F.), maximum tensile development is reached and the Fusion Viscosity has reached the end of its sharp decrease. This low final viscosity of the homogeneous solution of resin in plasticizer occurs at the temperature at which complete fusion is manifested both by tensile strength measurements and by the Hotbench "Fusion Point" (ethyl acetate) method.

The Fusion Viscosity test may be applied to a study of various plastisol formulating ingredients and can

serve as a guide to the choice of ingredients for compounding a plastisol with predetermined fusion properties.

When applied to the various resins used in plastisol formulation, the Fusion Viscosity points to interesting differences in their fusion characteristics. Fig. 6 shows the Fusion Viscosities of five commercial paste resins. The temperature of the Hotbench transitions (the "Haze," "Elastomeric," and "Fusion" points) for each resin are indicated on each curve.

In general, with all resins, the "Haze Point" occurs after an initial high rate of viscosity rise and near the beginning of a decreasing rate of rise. The "Elastomeric Point" occurs just before the resumption of another high rate of viscosity rise. It can be concluded from this, that all the paste resins in the study exhibit numbers of small particles which contribute rapid development of fusion properties to the plastisol.

The Hotbench "Fusion Points" of the resins charted in Fig. 6 occur at the leveling-off of the lower Fusion

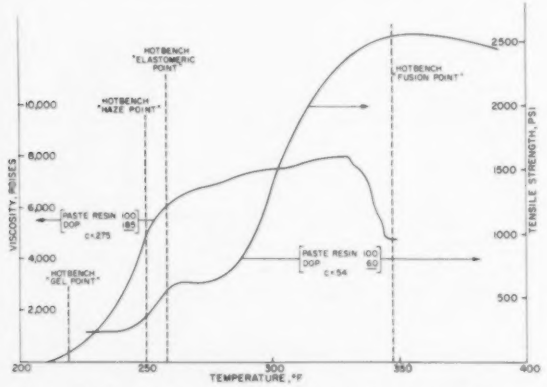

Fig. 5. Plastisol fusion viscosity, hotbench tensile strength, and hotbench fusion points.

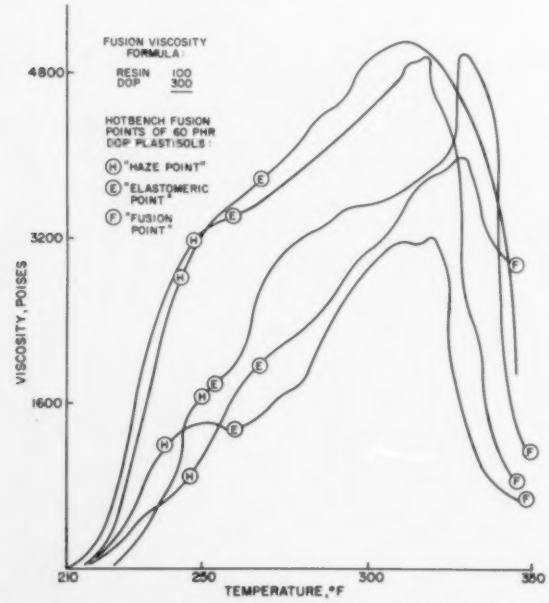

Fig. 6. Fusion viscosity of dispersion grade PVC resins.

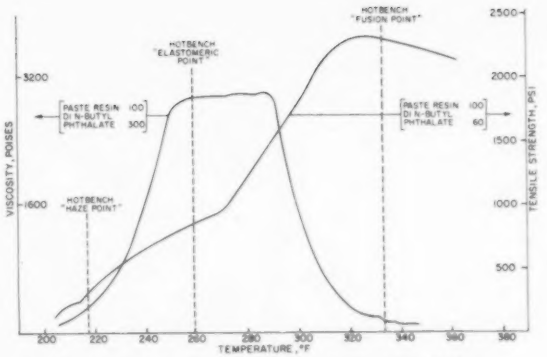

Fig. 7. Fusion characteristics of di n-butyl phthalate.

Viscosity of the melt and all occur between 345 and 350° F.

The maximum height of the Fusion Viscosity curve depends upon the rate of resin solvation before the breakdown of the solvated resin gel. The more rapid the viscosity rise, the greater will be the maximum viscosity.

Differences among the various resins (see Fig. 6) are noted in the configurations of their curves. This indicates differences in resin solvation rates, and may indicate differences in practical fusion characteristics which neither the Hotbench "Fusion Point" nor other one-point measurements of fusion would clarify. Certainly, there is little difference among resins in the ultimate fusion temperature or the time of fusion at this temperature.

The Fusion Viscosity curves show, however, a wide variation in fusion characteristics at temperatures below those of complete fusion. In practical terms, resins may be chosen which develop the most useful fusion properties at temperatures (and times) below those required for the attainment of the ultimate physical properties of the plastisol.

After resin, the next most important ingredient in a plastisol formulation is the plasticizer. It is well known that the choice of a plasticizer is important to the fusion properties. Figs. 7, 8, and 9 compare the Fusion Viscosity and tensile strength development with temperature for di-n-butyl phthalate, di-isodecyl phthalate, and a mixture of equal parts of these two plasticizers. The Fusion Viscosity curves bear the same relationship to their respective tensile strength curves and Hotbench transition points as was shown in the case where DOP was used as the plasticizer.

An interesting difference is the temperature at which the Fusion Viscosity begins to decrease. The Fusion Viscosity of di-n-butyl phthalate drops sharply at 290° F., at which temperature only 56% of the ultimate tensile strength is reached in the Hotbench fusion test. With the mixture of plasticizers, 95% of the maximum tensile strength is reached at 310° F., the point of sharp viscosity drop. With di-isodecyl phthalate, this point occurs at 340° F., with 100% of the maximum tensile strength reached. Complete fusion, as measured by the Hotbench Fusion Point, does not occur, however, until a minimum Fusion Viscosity is reached in all cases.

The height of the maximum Fusion Viscosity and the

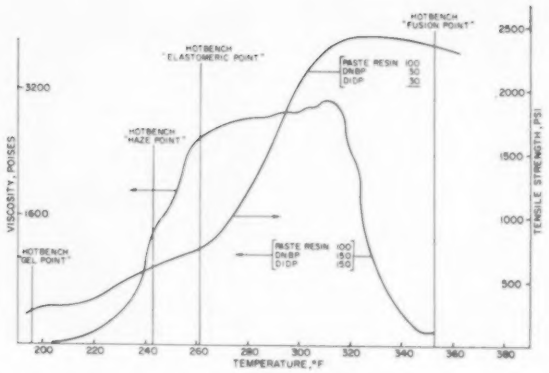

Fig. 8. Fusion characteristics of di n-butyl phthalate and diiso-decyl phthalate.

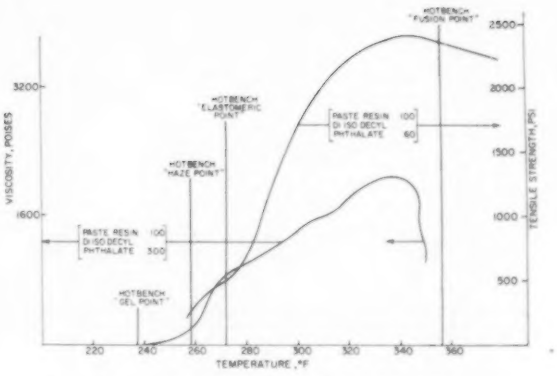

Fig. 9. Fusion characteristics of diiso-decyl phthalate.

temperature at which it occurs cannot be compared rigorously with the tensile strength development with temperature. This portion of the viscosity curve reflects the hot gel strength of the solvating resin and is not comparable to the strength of the cooled mixture. However, the temperature at which the decreasing Fusion Viscosity begins to occur can be used to give relative ratings to the solvating power of plasticizers and resin solubility.

Conclusions

In conclusion, the Fusion Viscosity method extends the same continuous viscometric measurements to the study of plastisol fusion that have been used for studies of plastisol gelation. By this method, the mechanics of plastisol fusion may be studied while fusion is taking place.

The test is validated by its conformity to results obtained by the Hotbench tests. The Fusion Viscosity test illustrates the route by which resin is solvated by plasticizer both in time and with temperature, and offers an alternate means of studying plastisol formulating ingredients for their effects on plastisol fusion.

Bibliography

1. W. D. Todd, et. al., **Modern Plastics** 34, 157 (1956)
2. J. A. Greenhoe, **Plastics Technology** 10, 43 (1960)
3. K. A. Akhmedov and S. N. Lipatov, **Kolloid Zhur.** (USSR) 19, 257 (1957)
4. L. Mandelkern, **Chem. Reviews** 56, 903 (1956)
5. A. J. Walter, J. **Polymer Sci.**, 13, 201 (1954).

—The End

Parkway bridge surfaces resist skidding and wear

Epoxy surfacing material is sprayed on one lane at a time by a single operator.

A program to protect more than 400 bridges on the Garden State Parkway against deterioration is being considered by the New Jersey Highway Commission. The treatment, which consists of spraying epoxy resin over the concrete, is now being tested on two bridges and two overpasses.

Sprayed directly onto the concrete, the epoxy adheres to the surface and protects it from salt and water penetration. Emery grit embedded in the coating forms a non-skid surface that provides added safety to high speed travel.

Working with engineers of Union Carbide Plastics Co. and Hunter-Bristol Division, Thiokol Chemical Corp., the Highway Authority chose the epoxy because of its resistance to wear and its ability to withstand expansion and contraction of the concrete without cracking. Since the sprayed resin hardens in a matter of hours, traffic lanes can be reopened quickly with a minimum of inconvenience to motorists.

—The End

Drying polyethylene sheathing compound prior to extrusion

While this article covers only extrusion of carbon black-loaded polyethylene, the same principles hold true for injection molding of other materials containing hydrophilic materials as fillers or pigments. Polyvinyl acetate, incidentally, is hydrophilic in itself. An additional problem in injection molding—there can be no devolatilizing vents as there are in long barreled extruders.—Editor.

F. H. KRUGER*

Early in August, 1957, we experienced considerable difficulty with blisters in carbon black-bearing polyethylene cable sheath. The worst blisters appeared as the extrudate left the die. At times, blisters appeared continuously along the length of the cables and the surface was often rough due to drooling.

Material was then being received in 50-pound paper bags and in 1,500-pound disposable containers known as Pillar-Pacs**. We noted that another plant using the 10,000-pound capacity rubber bags or Sealdbins*** did not experience this trouble. After some investigation, it was found that the blister condition could be corrected by drying the granular compound before extrusion.

In order to dry this polyethylene, the bags were opened and placed upright in mesh-type handling containers known as Cargotainers#. These Cargotainers were placed in a dehumidified storage room operating at 135°F. and approximately 3% relative humidity for 30 hours. The Pillar-Pacs were placed in vacuum driers used primarily to dry cable cores, the covers were removed, the drier doors were closed, and the material heated for 20 hours at 200° F. The driers were then evacuated to an absolute pressure of 1-2 inches Hg and dried for an additional 15 hours. After the bags were removed from the storage room, or the Pillar-Pacs from the vacuum drier, they were used within a period of four hours.

Moisture content determination

One of the first things we had to determine was the moisture content of the compound under different conditions. For anyone accustomed to paper with moisture of the order of 5%—10%, the answer was rather startling. As received from the supplier, polyethylene sheathing compound with a carbon black content of 2.6% had a moisture content from 0.02%-0.10%.

An approximation of moisture content might be made by observing the purgings from the extruder as they cool. If the moisture content is greater than 0.05-0.06%, small pockmarks occur on their smooth surface. As moisture content increases, there is an increase in the number of pock marks which will also occur in the extruded sheath.

Precise moisture content, however, can be determined only by quantitative chemical determinations. These involve special care in sampling and analysis to avoid errors due to moisture in the surrounding air. We, therefore, used a "thief" similar to the one employed in grain inspection in order to obtain a representative sample. After the material was dried, steps had to be taken to prevent moisture regain before analysis. Screw top bottles with rubber gaskets were used to hold the material. Before the samples were taken, the "thief" and the bottles were dried with hot dry air.

Several methods of anaylsis have been developed. In this paper the determinations made in connection with the moisture content (the relative humidity equilibrium curves given in the section on humidity conditions) were made by the nitrogen sweep method (1)#. In this method, moisture is evaporated from the material by heating. It is swept from the heating container by dry nitrogen and absorbed in a small vessel which contains pre-titrated methanol. This absorbed moisture is then titrated with Karl Fischer Reagent. The heating, sweeping, and titration steps are carried out in a closed system to prevent exposure to atmospheric moisture.

Factors affecting moisture content

Carbon content

From 2.35-2.85% carbon black is blended with the polyethylene resin. This material is used to filter out the ultraviolet rays and increase the resistance of the sheath to weathering. Actually, the carbon black in our sheathing compound averages approximately 2.6%.

* Senior Engineer, Western Electric Hawthorne Works, Chicago, Ill.
** A registered trademark of E. I. du Pont de Nemours & Co., Inc.
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MOISTURE CONTENT - RELATIVE HUMIDITY EQUILIBRIUM CURVE AT 77° F.

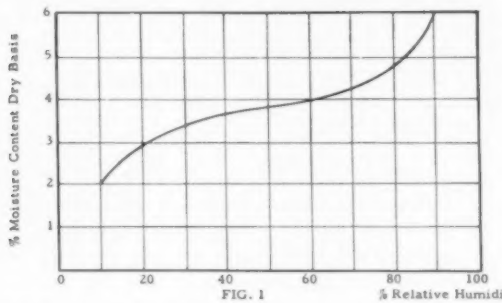


FIG. 1

Materials adsorb definite amounts of moisture when exposed for long periods of time to a fixed relative humidity and temperature. The resultant moisture is said to be in equilibrium with prevailing atmospheric conditions. Figure 1 (2) shows this relation for pigment grade of carbon black at various relative humidities and at a temperature of 77°F.

If it is assumed that the moisture content of polyethylene is directly proportional to the carbon black, then the extrusion compound will have a moisture content of 0.11% at 66% relative humidity and 77° F.

Humidity conditions

Moisture content—relative humidity equilibrium data were obtained for du Pont's Alathon 4, although other brands of sheating compound are used. The data were plotted as shown in Figure 2 (3). The material was exposed to air at temperatures of 80°F. and 167° F. The polyethylene was placed in desiccators, and the different humidities were obtained by exposing the samples to various concentrations of sulfuric acid. Before exposure in the desiccators, the material had a moisture content of 0.055%. For relative humidities less than 22% at 80° F. and 40% at 167° F., the moisture contents were obtained by desorption. For relative humidities above these values, the moisture contents were obtained by adsorption. The curves show the usual relation in that the moisture content varies inversely with the atmospheric temperature.

If the relative humidity and temperature are known for the area in which the polyethylene is stored, it is possible to approximate the equilibrium moisture content in the polyethylene from the above curves after prolonged storage. During the years 1922 through 1924, an investigation was conducted at Hawthorne in which it was desirable to record the temperatures and humidities in the Cable Plant. These average daily maximum and minimum temperatures and relative humidities are shown in Table 1.

Table 1. Average dry bulb and relative humidity for three year period in cable test room

	Aver. daily maximum		Aver daily minimum	
	Temp.,	Rel. humidity,	Temp.,	Rel. humidity,
Month	°F.	%	°F.	%
January	68	53	62	44
February	67	56	62	44
March	68	58	63	45
April	70	61	64	46
May	75	66	65	47
June	80	72	70	50
July	83	75	72	54
August	80	75	70	57
September	76	70	69	56
October	73	66	66	52
November	70	60	63	46
December	68	54	62	42

Table 2. Quality of extrudate obtained with various moisture contents

Sample designation	Moisture content, %	Quality of extrudate
A	0.075	Rough sheath (Pockmarks in purgings)
B	0.067	Slightly rough sheath
C	0.060	Rough sheath (Pockmarks in purgings)
D	0.051	Rough sheath (Pockmarks in purgings)
E	0.045	Smooth sheath (No pockmarks in purgings)
F	0.039	Fairly smooth sheath
G	0.023	Smooth sheath (No pockmarks in purgings)
H	0.017	Smooth sheath
I	0.009	Smooth sheath
J	0.009	Smooth sheath (No pockmarks in purgings)

If the sheathing compound were allowed to come to equilibrium with the air conditions mentioned above, it would have a moisture content of 0.10%-0.11% in January, approximately 0.11%-0.13% in July. It was determined (see conclusion to Table 2) that the moisture content should not be greater than 0.04% for proper

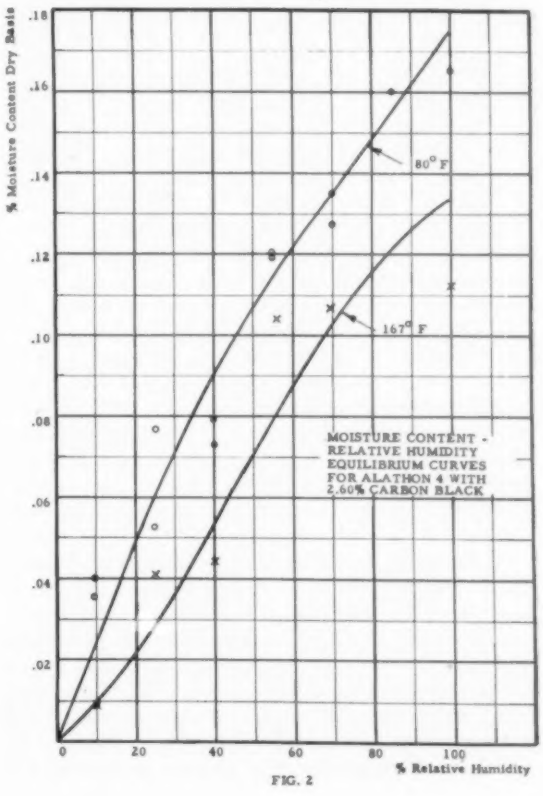


FIG. 2

extrusion conditions. Accordingly, provisions must be made to dry such material or otherwise prevent moisture regain. A storage room at 80° F. and 16% RH would be required to obtain an equilibrium moisture content of 0.04%. It would be necessary to dehumidify this room because a dewpoint of 30° F. must be obtained. Approximately the same moisture content can be obtained under summer conditions with a maximum average dewpoint of 72° F. and heating to 121° F. The same moisture content can be obtained, therefore, either by dehumidification or by heating.

Why was blistering encountered in August, 1957, whereas it had not been a serious problem in previous years? Four weeks' stock of polythylene was carried. The manufacturing operations are shut down for the standard vacation period during the last two weeks of July. The Weather Bureau reports indicate that during July, 1957, Chicago experienced the second highest rainfall on record. The records also show that the outside dewpoints were higher for June and July, 1957, than they were the previous year. Likewise, relative humidities were somewhat higher. Consequently, it is believed that the higher humidities resulted in increased moisture in the sheathing compound which, in turn, gave us a high rejection rate. Similar difficulty was experienced about the same time at two other plants applying cable sheath. The weather conditions in these plants were like those in the Chicago area.

Maximum allowable moisture content

For control and design purposes it was necessary to determine the maximum moisture content which could be allowed in polyethylene extrusion compounds. Materials having different moisture contents were tested. These findings are given in Table 2.

From these data it was concluded that the moisture content of polyethylene containing 2.6% carbon black should not exceed 0.04% for optimum extrusion.

Obtaining desired moisture content in polyethylene sheathing compound

In order to obtain polyethylene with the maximum moisture content of 0.04%, a cable manufacturer has four courses of action open to him:

1. Use of devolatilizing extruders.

2. Exposure of material in a low humidity storage room. If large enough rooms are available, they offer a satisfactory method of conditioning the material. Long exposure periods will be required if polyethylene is received with a moisture content of 0.08-0.10%. If it is a question of building a new storage room for this material, it would be more costly than some of the other methods of conditioning.

3. Obtaining the polyethylene from the producer at a sufficiently low moisture content and subsequently preventing the regain of moisture during storage. This can be accomplished by shipping in rubber Sealdbins or sealed hopper cars. Moisture adsorption must then be prevented during subsequent handling and storage.

4. Drying the polyethylene before extrusion. Although this process was relatively new, it offered the best solution of our moisture problem at Hawthorne.

Principles of drying

A material may or may not contain moisture in excess of the equilibrium value. A term known as "Bound" moisture (4) applies to the equilibrium conditions. Bound moisture is that water held in a solid which exerts a vapor pressure is less than pure water at the temperature of the solid. Bound water may be present under several conditions: in small capillaries which will exert a lower pressure due to the concave curvature of the water surface; in fibers or cells which may have a lower vapor pressure because of dissolved material; and in organic structures (physical and chemical combination) the strength of which may vary with the moisture content. The moisture in the polyethylene as received from the supplier is usually only of the bound type.

If a material contains more moisture than is indicated by the equilibrium conditions, then the term "unbound" (4) moisture is encountered. This is the moisture which exceeds that corresponding to 100% RH. It always exerts its full vapor pressure corresponding to its temperature. During the blending and granulation operations the polyethylene is usually quenched in water. Under these conditions both bound and unbound moisture are present. The amount of the unbound moisture, however, exceeds the bound moisture.

"Free" moisture (4) is that water which can be removed at a specific temperature and relative humidity. It may include both unbound and bound water. Drying involves two separate processes: the transfer of heat to raise the temperature of the material and evaporate the moisture, and the mass transfer of the moisture to the surrounding air. These transfer processes are taking place at the same time.

During drying we are concerned with the equilibrium moisture content and the rate. Often, the cycle is not continued until equilibrium is reached. Under a constant set of conditions of air movement, temperature, and humidity, there will be a typical moisture content —time relationship as shown in Figure 3.[5]

Drying polyethylene sheathing compound

The drying rate and material temperature may be plotted as a function of time as shown in Figure 4.[5] AB is the heat-up period, BC the constant rate period, and CD the falling rate period. The moisture at C is known as the "critical" moisture content. It is thought

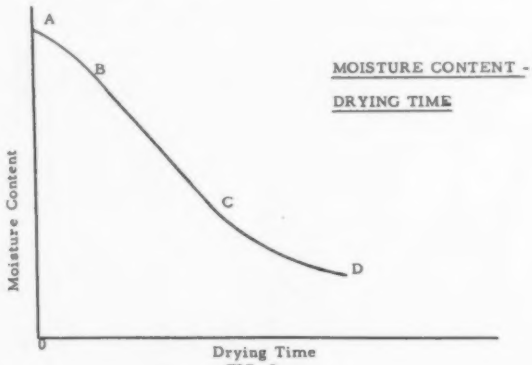


FIG. 3

to vary with the drying conditions. The moisture content at D represents the equilibrium moisture content which prevails at the temperature and humidity of the drying air.

By means of the circulating air, heat must be supplied to offset the losses from the drier, raise the temperature of the material and the moisture, and evaporate the moisture. The following relation will prevail in the constant rate zone:

$$\text{Rate of Drying} = \text{Rate of Heat Transfer} = \text{Rate of Mass Transfer of Moisture}$$

During this period, it is presumed that evaporation takes place from a completely wetted surface of a solid. Water vapor from the surface diffuses through a stationary air film which surrounds the solid into the moving air. The thickness of the film varies inversely with the air velocity. The portion of the film adjacent to the solid is assumed to be saturated as long as the surface is wet. If the moving air stream is not saturated, a vapor pressure differential exists between it and the surface of the solid. This difference is the driving force which promotes diffusion of the water.

As for the drying rate, the rate of heat transfer to the material and the mass transfer of the moisture through the saturated film to the moving air are of special importance. The temperature of the wetted surface should be the same as the wet bulb temperature (actually the temperature may be somewhat higher because of the transfer of heat by conduction and radiation). Of necessity, the rate of heat transfer must be equal to the rate of mass transfer.

The drying rate (5) during the constant rate period for air flow parallel to a plane wetted surface consequently is given by the equation:

$$\frac{dw}{d\theta} = \frac{Ah_t\Delta t}{i} = k_g A \Delta p \;\#\#$$

If all the heat is transferred by convection then

$$h_c = h_t$$

If the heat is transferred to a surface by parallel air flow, the heat transfer coefficient is:

$$h_c = 0.0128\ G^{0.8}$$

The quantity transferred will be:

$$Q = 0.0128\ G^{0.8}\ A(t_a - t_w) \text{ per hour}$$

If we consider that this amount has been transferred solely for the evaporation of moisture,

$$\frac{dw}{d\theta} = \frac{0.0128\ G^{0.8}\ A\ (t_a - t_w)}{i}$$

The drying rate decreases or falls at C in Fig. 4.[5] In this falling rate zone, there is not enough free moisture evaporated to saturate the surrounding air. During the constant rate period, the temperature of the material approximates the wet bulb temperature of the air. As the rate decreases, the material temperature increases. Less moisture may be evaporated in the falling rate period than in the constant rate period; however, more time may be required. The decreased rate may be due to the fact that the exterior surface of the material is partially dry, or it may be due to the limited transfer of internal moisture.

The internal transfer may be controlled by such

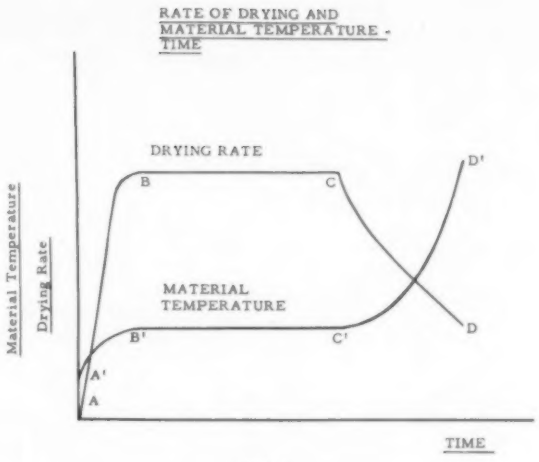


FIG. 4

conditions as diffusion, capillarity, and pressure gradient due to shrinkage. The critical moisture content which prevails at the junction of a constant rate and falling rate curve has not been determined for polyethylene as far as the author is aware. It is possible that this value may vary depending upon the shape and size of the granules, and with the drying conditions. For design purposes, it is significant in determining the drying rates in the falling zone.

Equipment selection

The first piece of equipment selected was the dryer. There are a number that will perform satisfactorily if operated under the proper conditions; we chose a hopper dryer. Because of through circulation it dries rapidly. These dryers can be of the central type serving a number of machines, or one dryer can serve one extruder. In the latter case, the hopper is mounted directly above the throat of the extruder. A hopper dryer requires no additional loading or handling labor, and eliminates the possibility of moisture regain after drying. Although this dryer is well suited to pre-extrusion drying, design equations have not been developed for it.

Drying involves heat and moisture balances. The hopper dryer is of the convection type, which supplies the necessary heat and removes the water vapor by circulating air. In designing the hopper, we realized that consideration must be given to channeling of the polyethylene during gravity flow and temperature of the polyethylene.

Non-uniform flow or channeling could be present in a device of this type. In order to study this possibility, a transparent plastic model was constructed. The hopper was filled with one color of granular material, and the flow gate at the bottom was opened. Another color of material was added to the top. It was noted that approximately 60% of the original granules ran out before the new granules appeared. Several types of baffles were used, but they did not improve results significantly.

The machine hoppers are similar to the model. In order to check the flow data obtained on the model, a similar test was run on the full scale unit. In this case, it was found that 82% of the original material ran out

Nomenclature

References

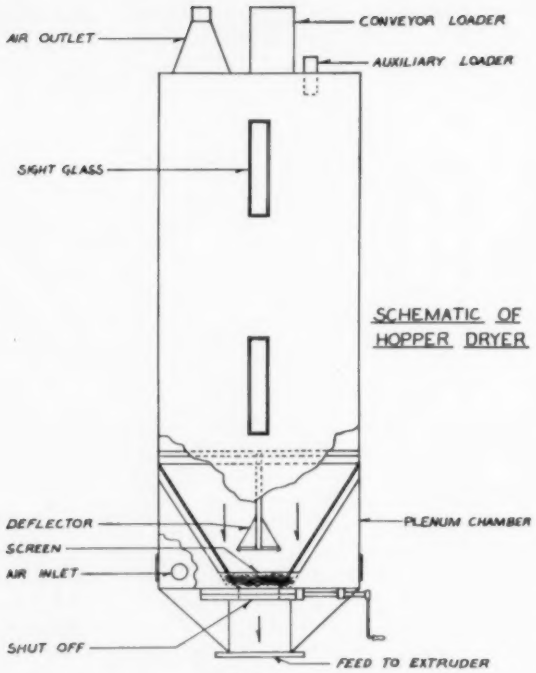


Fig. 5

before the new material appeared. The improvement was probably due to a more advantageous scale factor. This test was made with an 850 lb./hr. extruder consumption. It is possible that the percent flow-out might change with the extruder output; however, it is not expected that the variations would be great enough to result in a channeling problem.

The hoppers are shown schematically in Figure 5. Note that the polyethylene is fed in at the top, flowing down and into the extruder through the funnel shaped bottom. A plenum chamber surrounds this funnel. The incoming air enters the chamber, passes through a screen which forms the bottom of the funnel, and blows up through the granules. It is removed through the conical connection at the top and recirculated to the dehumidifying units which will be discussed later. Air was introduced over the entire bottom of the hopper.

Uneven drying occurred. Checking the flow in the model, it was noted that the granules of sheathing compound moved down more rapidly through the center core of the drier. It was concluded that the major amount of air flowed up around the outside of the hopper because it took the path of least resistance. In order to introduce more air in the region of greater polytheylene flow it was necessary to block off the air inlets at the outside of the funnel.

The maximum temperature of the polyethylene is important. We found that if the temperature exceeds 180° F., "caking" or adhesion of the particles to one another takes place. As previously stated, the critical moisture contents of polyethylene sheathing compounds which are associated with the intersection of the constant and failing rate zones, are not recorded in the literature. Consequently, it was not known if drying would be terminated in the constant rate zone at approximately the wet bulb temperature of the air or in the falling rate zone at some value appreciably above the wet bulb temperature. In view of the considerations mentioned above, air supply units were selected which gave a degree of operational flexibility. These units employed a solid desiccant known as Molecular Sieve.# The viewpoint of the effluent air is 0° F. or less, and its temperature may be varied from 100° F. to 250° F.

Operation with commercial dryer

Several factors affect the performance of commercial hopper dryers: changes in extruder screw speed and consequently changes in the output; variations in drier face velocity; variations in plenum temperatures and humidities; and variations in moisture content of the incomping polyethylene. We have endeavored to maintain the plenum temperatures between 180° F. and 190° F., and the dewpoints between —25° F. and —35° F. Face velocities of 20, 30, and 40 feet per minute have been used in the hopper. Average polyethylene temperatures of 100° F. have been obtained with outgoing moisture contents from 0.03%-0.04%. Average compound temperatures of 120° F. have been obtained with outgoing moisture contents from 0.02%-0.03%. Under the conditions mentioned, it has been observed that the drying air temperature drops rapidly as it passes upward through the hopper.

Summary

To conclude, this study indicates that blisters and rough sheath may be avoided by drying polyethylene to a moisture content of 0.04% or less. The moisture content of the polyethylene is due to moisture in the blended carbon black. If material is stored for a long period of time, summer or winter, the maximum allowable moisture content may be exceeded. Drying depends on the temperature, humidity, and velocity of the drying air; the output of the extruder; and moisture content of the incoming polyethylene.

Nomenclature

A = area of heat transfer and evaporation, sq.ft.
G = mass velocity of air, lbs./hr./sq.ft.
h_c = coefficient of heat transfer by convection, BTU/hr./sq.ft./°F.
h_t = total gas film heat transfer coefficient, BTU/hr./sq.ft./°F.
k_g = mass transfer coefficient/hr./sq.ft./atmosphere
Δp = $p_s - p_a$, atmospheres
p_s = vapor pressure of water at t_s, atmospheres
p_a = vapor pressure of water in drying air, atmospheres
Q = total heat supplied, BTU
t_a = air temperature, °F
t_s = temperature of particle, °F
t_w = wet bulb temperature of drying air
Δt = $t_a - t_s$, °F
W_c = critical moisture content, lbs. of water per lb. of dry material
$\frac{dw}{d\theta}$ = drying rate, lbs. of water/hr./lb. dry material
i = latent heat of evaporation, BTU/lb.

(*Continued on page 52*)

A registered trademark of the Linde Co.

Will the plastics of today be around tomorrow?

Product Research and Development

J. L. ROGERS*

In an age dominated as is ours by science, we are confronted by such wondrous discoveries and accomplishments in the numerous disciplines of science that a merely extraordinary event seems commonplace and pallid in comparison.

Our news media are filled with announcements of breakthroughs in atomic energy, space travel, undersea missiles, and interplanetary communication. In the face of such competition, news of an improved auto tire or a clever labor-saving device for the household tends to be ranked with space filler—with those items that neatly fill out columns and inform us: "In 1958, 406,274 bushels of corn were destroyed by mice in South Dakota."

Now this is an unrealistic situation and, granted that space travel has a large element of importance, better tires and labor-saving devices are also important; and, as a matter of fact, it is worth more than passing notice that those mice made off with that much loot.

So, what does this all have to do with our business of plastics? Just this—I believe that a similar distortion of relative values, even though to a lesser extent, exists in our industry today. It has become fashionable to cry out for more basic research and to denigrate mere product improvement and application research. The one is noble, the other—not quite shameful, perhaps, but like beer, is not to be considered in the same class with champagne.

Before I am pilloried by indignant exponents of basic research, I hasten to affirm my belief in the very real need for a proper balance of investigation in pure science. But there is room for both, and neither need thrive at the expense of the other.

To provide a framework of reference, the years have brought us some 20 basically different plastics. Such a count would consider all the cellulose esters as a single entity; all the phenolics, whether molding, coating or other type, as a single plastic. Depending upon the ground rules laid down, the precise number of basic materials is debatable but, in any event, is rather small. This fact could be construed as sound argument for more fundamental research, and taken as evidence that in the field of plastics, as in other areas, we are running out of basic knowledge upon which to build our future.

Again taking a stand that can, but should not, be considered anti-basic research in nature, it must be said that the notion of "running out of basic knowledge" is one of the most palpably unrealistic notions that has been expressed since the announcement by the U.S. Patent Department official in the 1800's that he was resigning his office because nearly everything had been invented.

Have we run out of basic knowledge? Let's look at the granddaddy of the all-synthetic plastics—phenolic resin. Here, certainly, is a material that represents a genuine breakthrough in science and technology, a breakthrough that took place half a century ago. Have we run out of basic phenolic knowledge: that is, have we done all we can with this material, developed it to the limit of its capabilities and closed the laboratory notebook for the last time? Not by a long shot! In fact, we are assigning this year more man hours of research and development time to phenolics than were spent during the first 10 years following its discovery.

Fifty years represent a long period of time for a product to defy obsolescence, and it has done so only because it is a sound, useful material that has been

* Director of Sales, Union Carbide Plastics Company.

continually researched to make it a better product—both for old applications and to adapt it to the new. We have by no means discovered all its secrets nor exhausted its ultimate potential.

Phenolics were used in coatings, yet some of our most recent work has resulted in the development of greatly improved phenolic coatings. Phenolics were early used for their good resistance to elevated temperatures. Fifty years should see any further potential in that respect pretty well exhausted. But we have, just coming out of our laboratories, new phenolics that can withstand temperatures of 500F., four times as long as the best previously heat-resistant phenolics.

If such a major development can take place after 50 years of continued research, how many other facets of the phenolics are yet undisclosed? More than a few.

Among much newer plastics, the same situation exists. The discovery and practical development of polyethylene was a major scientific achievement. We are proud to have had a strong part in the massive assault on the problem of its production in this country during World War II. Intensive effort paid off in the production of quantities of material ample for radar and other high priority, military applications. Later, broader applications became apparent. It was a wonder product, having extraordinary properties, and rapidly found many uses not at first envisioned. But again, has the book been closed on polyethylene—even considering only low-density types? And again, the answer is obviously no.

There are still many aspects of its synthesis and modification not yet completely clarified. When understood, they will make possible new product characteristics and new applications. I consider it neither a matter of optimism nor pessimism to suggest that after 50 years we may still be learning new and useful facts about polyethylene and developing considerably improved forms of this plastic.

To return to the matter of basic research, we must continue to maintain a strong program of research directed at revealing completely unknown areas of knowledge. But at the same time, let's maintain a well-balanced, positive program of research and development on the plastics of today to meet today's needs. These needs are endless—better heat resistance, better low temperature properties, fire resistance, self-extinguishing plastics, and better light and weather-resistant materials.

While seeking the next wonder plastic—the plastic of tomorrow—we have this immensely intriguing and worthwhile job at hand—to provide materials capable of meeting the increasingly rigorous demands of industry. These plastics we have are pretty good products, and they still have a lot of undiscovered potential. By the time tomorrow rolls around, we may have learned enough about them to discover that they are what we were looking for all along—the plastic of tomorrow.

—The End

Space travel may enhance polymers

An experimental solar condenser is steadied as it slowly inflates.

Plastics sent into space as films, foams, and coatings for solar collectors and other expandable structures may become stronger than on earth when exposed to environmental extremes that can weaken or destroy metal.

According to Dr. Carl E. Snyder of Goodyear Tire & Rubber, laboratory experiments with extreme vacuum and ultraviolet radiation indicate that polyethylene terephthalate and polypropylene films are the outstanding candidates for travel under arduous space conditions.

Dr. Snyder's work yielded three important results. First, polymers have lower volatility than metals and therefore will not boil away as easily as metals in near-complete vacuum. Second, those molecules which do boil away from polymers in vacuum are generally the weak points of the system, and often leave behind an enhanced polymer. Third, the tendency of polymers to deteriorate under ultraviolet radiation can be beneficial. Gases such as oxygen tend to fuse to the ends of molecular chains broken by ultraviolet bombardment, making the break permanent. Such gases are so scarce in space that even if the molecular chains break, they can recombine to form a strong, or stronger, structure.

When seamed films of one-mil polyethylene terephthalate, aluminized on one side, were exposed to vacuum and ultraviolet bombardment, in some cases there were even increases in tensile strength.

—The End

Infrared analysis and epoxy formulation

There are actually two methods for obtaining a chemical profile: the spectrophotometer, described in this article; and the gas chromatograph, which is limited to volatiles. While described for use with epoxies, it should also be of value to the formulator of vinyls, copolymers, and compounds containing nitrile groups. Going back a step further, it can assist in the tailoring of polyolefins. —Editor.

DR. HENRY L. LEE*

Infrared spectrophotometers operate by passing various frequencies of infrared radiation through small test samples. These frequencies are absorbed when they encounter resonant molecular vibrations of any component in the sample. Measurement and recording of the absorption percentages gives the complete chemical profile.

This qualitative and quantitative analysis permits positive identification of sample, components, and molecular structure. Sample materials are not affected by infrared analysis, and repeated runs of the same sample can be made to study reaction mechanisms as they occur. This is of special interest in plastics formulating.

Our firm has built up a comprehensive reference library of infrared spectrograms covering a broad range of standard and specialized epoxy formulations. Since spectrographic data can be interpreted in terms of resultant physical and chemical properties, we use an Infracord** spectrophotometer to "design in" the required characteristics of epoxies destined for such diverse uses as motor encapsulation, adhesives, and coating materials.

Principles of operation

Figure 6 shows the optical principles schematically. Radiant energy from source is split into sample and reference beams by plane mirror and toroid mirrors. Lower beam proceeds through sample, upper beam through optical attenuator. Sector mirror recombines beams as alternating pulses of sample and reference radiation. Resulting signal beam passes through entrance slit of monochromator, is dispersed into infrared wavelengths by prism, and is focused on exit slit. Particular spectral wavelength that emerges from slit is focused on thermocouple target.

If sample and reference beam energies are equal, no electrical amplification results. But when sample absorbs radiation at characteristic wavelengths, intensity of sample beam is reduced, and detector produces differential signal that is amplified and used to drive servo motor. Motor moves optical attenuator into or out of reference beam to null beam intensities. Since recorder pen is coupled directly to attenuator, its chart track provides accurate record of sample absorption at specific wavelengths.

Areas of Application

Infrared analysis plays a major role in nine areas at Epoxylite. Correlations between molecular structure or general chemical composition are analyzed together with a product's physical and chemical characteristics. Reaction mechanisms are studied by running repeated tests of the same sample as curing occurs. Quality control is assured both for incoming raw materials and during production runs. Contaminants are detected, identified, and eliminated.

The system also affords identification of raw materials offered under non-descriptive proprietary names or numbers. Competition can be surveyed. Infrared analyses of competitive products in combination with their technical literature and price lists reveal raw material costs and mark-ups. Published test and application data may be interpreted directly in terms of the product's formulation. Because of these infrared analytical capabilities, trade secrets are a vanishing factor in this business. Market surveys of a proposed new area of operation may be aided by obtaining information on current technologies and marketing practices via infrared analyses of available products. Simple analyses of materials for customers can be offered as a service. Finally, we test plastic materials that are under consideration for packaging or other similar uses.

Case Histories

In a typical example, correlations made by infrared between molecular structure and a product's physical and chemical characteristics are illustrated in Figure 1. This is the infrared spectrum of a typical epoxy resin

* Vice-President and Technical Director, The Epoxylite Corp., El Monte, Calif.
** A registered trademark of Perkin-Elmer Corp., Norwalk, Conn.

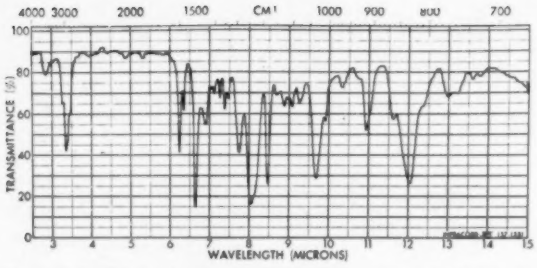


Fig. 1. Infrared spectrum of typical liquid epoxy resin based on epochlorohydrinl-bisphenol A.

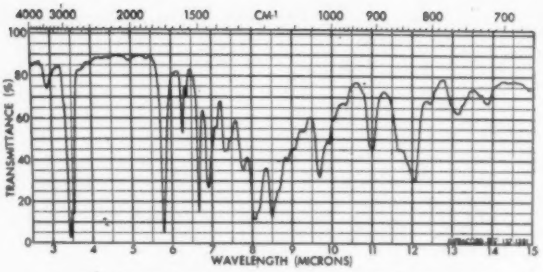


Fig. 2. Infrared spectrum of a new glycidyl-ester resin.

made from epichlorohydrin-bisphenol A. The major absorption bands and their significances are as shown on page 49. This shows that by interpretation of the spectrum (See Fig. 2), general structure can be determined, thus indicating its chemical reactivity and suitability for different types of applications.

The time required by the spectrophotometer to run spectra is approximately 15 minutes (including cell loading). Interpretation takes about 30 minutes. A spectrum such as Figure 2 can save several days of laboratory screening time by other methods. Reaction mechanism studies have always been time consuming and usually too expensive for routine consideration by small specialty companies. But infrared changes the picture.

For example, a new curing agent under study in our laboratory for a certain coating application gave room temperature gels in 2 hours. However, we wanted to know how long it took to achieve full cure, so that full chemical resistance of the coating would be available to the customer. Conventional tests would have involved an extensive series of chemical resistance tests, or analysis by tedious "wet" methods of a series of samples. With the Infracord, a single sample was merely run every few hours the first day, then daily after that, until the epoxy groups disappeared, after one week (as shown in Figure 3).

Infrared also aids quality control of incoming raw materials. In the past, small companies could not afford to make quality control checks of small lots or single drums. But the fast-scan features of the spectrophotometer make such studies highly practical. It gives individual chemist great analytical power, in fact greater analytical power than even the largest chemical companies had until World War II.

In one case, a substituted imidazoline was being purchased as a wetting agent for certain adhesive formulations. It worked satisfactorily for several years. However, we received one shipment that had a heavier compound separated out at the bottom of the drum. Infrared spectra of the standard material (Fig. 4) and separated compound (Fig. 5) showed that the latter contained a high percentage of amide rather than an imidazoline. The amide had formed because of the particular reaction conditions used by the supplier in making that batch.

The supplier, although a fairly large chemical company, did not have infrared, and conventional wet analysis had not detected the difference in the batch. With infrared, however, we quickly noted the differ-

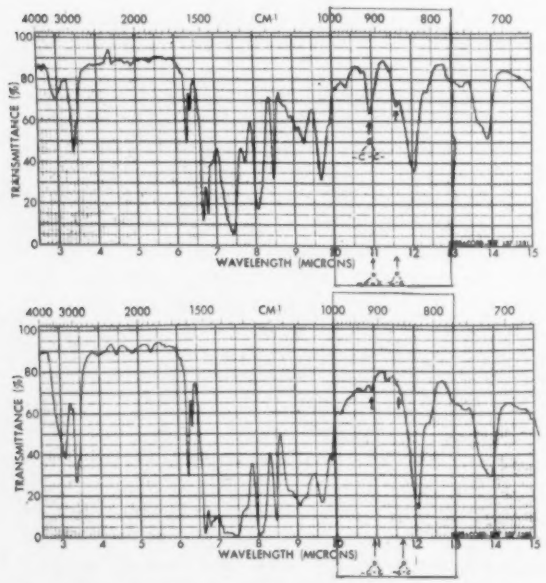


Fig. 3. Reaction rate studies. Epoxy resin and curing agent mixture 4 minutes after mixing and 1 week later, showing disappearance of epoxy group absorptions at 10.93 and 11.6 microns.

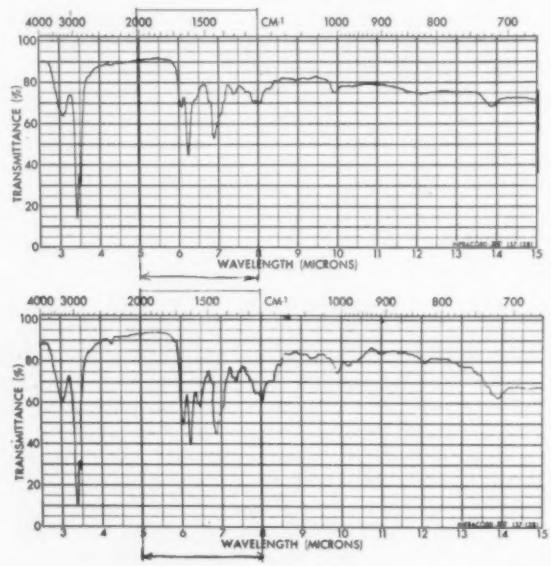


Fig. 4. Comparison of two batches of substituted imidazoline possessing significantly different wetting-action properties.

Band	Assignment	Significance
2.85 microns	Small amount of hydroxyl groups	Indicates that polymer is not pure diglycidyl ether of bisphenol A-epichlorohydrin but contains some higher molecular weight species. Small amount of hydroxyl groups is useful in promoting good cure by both amine and anhydride type curing agents.
6.23, 6.34, 6.63, 12.05 microns	Major amount of disubstituted benzene rings	Presence of benzene rings usually implies good heat stability, good electrical properties, and good chemical resistance.
6.9 microns	Short methylene chain	Means system tends to cure to rigid rather than flexible thermoset.
8.05 microns	Major ether and epoxy content	Ether content is major factor in causing resin to be liquid, rather than solid as are most uncured phenolic or benzene-ring containing resins.
9.06 microns	Absorption intensity indicates absence of monofunctional epoxy diluent	Monofunctional diluents lower viscosity before cure but degrade heat stability of cured material.
10.93 and 11.6 microns	Terminal glycidyl epoxy groups	Terminal epoxy groups, particularly the glycidyl type, are highly reactive with amines, giving good room temperature curves.
3.45, 3.52 microns	Major methylene content	Long-chain methylene groups imply a flexible resin, if cured with difunctional or low functionality curing agents.
5.78 microns	Carboxyl groups present	Lead to analysis of resin as a glycidyl ester rather than glycidyl ether. Glycidyl esters tend to cure slower than the others.
6.23, 6.34, 6.63 microns, etc.	Disubstituted benzene rings	Attributed to significant portion of epichlorohydrin-bisphenol resin added by resin manufacturer to speed cure of glycidyl ester resin.

ence. And, as a matter of fact, physical tests of the epoxy compound made with the "off" batch showed it to be actually superior, so future orders specified that type of batch. It is interesting to note that the larger chemical company acquired infrared within three months.

Manufacturing quality control is vital, if an epoxy resin formulator is to supply materials to major companies for encapsulation of equipment. Often, an electrical or electronic product containing several thousand dollars worth of expensive, complex components will be

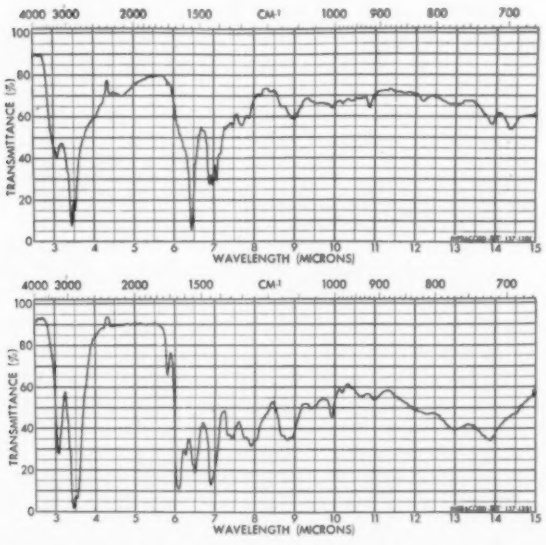

4000 3000 2000 1500 CM-1 1000 900 800 700
TRANSMITTANCE (%)
WAVELENGTH (MICRONS)
4000 3000 2000 1500 CM-1 1000 900 800 700
TRANSMITTANCE (%)
WAVELENGTH (MICRONS)

Fig. 5. Spectra of acid-amine salt before reaction in processing kettle, and after reaction over to an amide structure. Completion of reaction is determined by infrared. Note trace of excess acid remaining as indicated by minor band at 5.9 microns.

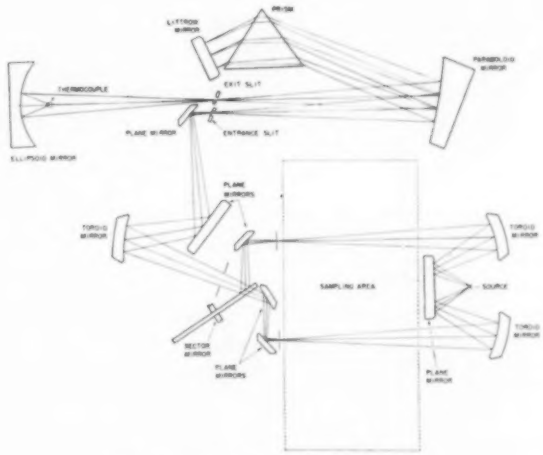


Fig. 6. Optical schematic of infracord.

encapsulated in four or five dollars worth of epoxy. If resin quality is not controlled, high exotherm and high shrinkage rates may damage heat-sensitive components, strip enamel off wire, and cause short circuits. Or they may crack open the encapsulation and make the entire product worthless, except for salvage.

A typical example involves amides, where infrared provides the fastest analysis we know for checking quality. The manufacturing problem revolves around determining the exact temperature (about 450° F.) and holding time for a given size batch in a given reactor kettle, so as to drive the acid-amine salt over to the amide. The large difference between the spectrum of the raw material (an acid-amine salt and its product, an amide, Fig. 5), makes spectra interpretation very fast. —THE END

C. L. Carlson

E. M. Halluska

Bench molding with lightweight molds

This article points out how aluminum alloys can be treated to give them the necessary wear resistance required for a heat-resistant polyester molding. Being lightweight, these molds could then be used in bench molding, which limits mold weight to 60 pounds. The treating process could be either the Martin, which gives a surface build-up of 0.001-0.004 inch; or the Aluminite, which builds up 0.001-0.002 inch. The coating is very hard, but watch your tolerances remembering to allow for the build-up.—Editor.

C. L. CARLSON* and E. M. HALLUSKA**

Due to their light weight, aluminum alloys were considered for use in a newly designed mold for a turbine generator vent cap to be made of heat resistant polyester resin. Although these alloys do not ordinarily have the resistance to wear, scratching, gouging, and galling needed for such an operation, the necessary hard surface was readily obtained by using an electrolytic process known as hard coating or hard anodizing. This process can be used for surface-hardening aluminum alloys up to 50 on the Rockwell "C" scale, and has been available and in full commercial use for some time. A mold was then designed, built, and hard anodized with a 1-mil thick coating. Figure 1 shows the four-part mold after anodizing.

Importance of weight

The requirements of bench molding limit the complete mold weight to less than 60 pounds. Mold designs which exceed this weight limit require press mounting—invariably more complicated and more expensive than a bench operation. Since all aluminum alloys are about one-third as dense as steel, it follows that the size of a bench mold may be substantially increased without exceeding the imposed weight limitations of 60 pounds. If the vent cap mold had been made of conventional tool steel, it would have been too heavy for bench molding. In aluminum, it is well under the maximum weight.

Importance of surface hardness

The two factors which depend on hard mold surfaces are good wearing quality—necessary for long time economy, and good operating quality. The latter is needed to permit easy release after the molding cycle plus good surfaces on the molded parts. If a suitably hard surface could not have been applied to the aluminum alloy mold, there would have been small likelihood of success in this application.

Whether or not crazing of the hard coated surface would occur during the mold operation was not known, but was of considerable concern. A crazed surface would prevent easy release of the molded part. However, experience with other hard-surface applications has shown that when a relatively large mass of metal (hard or soft) supports a hard surface and applied stresses are low, crazing or cracking of the hard surface layers does not occur. The mold is expected to remain in usable condition for a considerable time, but its actual service life can be determined only by extended use.

Alloy selection

Stock availability of suitably sized, wrought shapes (3-inch thick plate) was the primary factor in selecting

* C. L. Carlson, Materials Laboratories and
** E. M. Halluska, Component Products Division, Westinghouse Electric Corp., East Pittsburgh, Pennsylvania

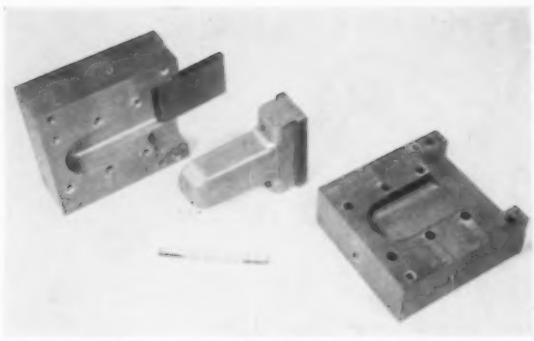


Fig. 1. All four parts of the aluminum alloy mold are hard anodized.

the fully heat treated aluminum-magnesium-silicon alloy (AA 6061-T6) used for the mold. Properties of this alloy, as well as of several others, are more than adequate.

All heat-treated aluminum alloys eventually soften after extended periods at elevated temperatures. Since a baking cycle in the mold of about 15 minutes at 160° C. (302° F.) is needed to cure the vent cap properly, extensive tests were conducted. The results were published by Aluminum Company of America. They show that Alloy 6061-T6 will retain its original strength for over 500 hours and will not lose more than 20 percent of its strength in about 25,000 hours at 150° C. (302° F.).

Test procedures

Figure 2 shows the hard anodized mold and one of the vent caps produced in a successful test run of 30 pieces. This was sufficient to show the following advantages from the use of hard anodized aluminum alloy mold in place of a conventional tool steel mold:

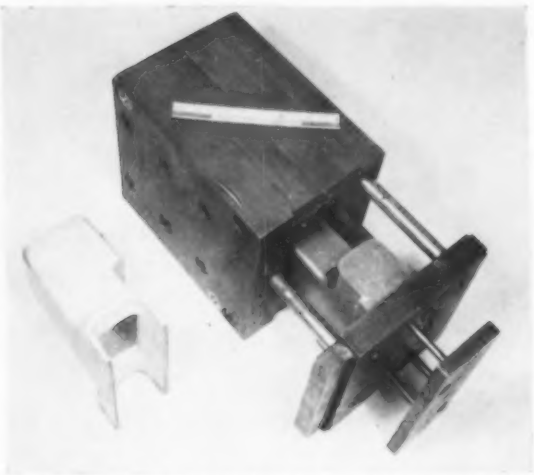


Fig. 2. The hard anodized aluminum bench mold is shown together with a generator vent cap of high-heat-resistant glass-polyester resin produced in the first run.

1. A 35% cost reduction was effected due to the excellent machinability of aluminum in relation to that of conventional tool steel.

2. The lesser weight of the aluminum mold permitted use of lower cost bench molding in place of machine molding.

3. A lower scrap ration was realized because the excellent surface of the mold allowed easy release of molded parts with no gouging, scratching, or galling of either mold or product.

4. Greater uniformity of molded parts was achieved through the inherently uniform heat flow through the walls of the mold. Examination of the mold after its production run showed it to be in excellent condition for further use.

—The End

Encapsulation protects motor coils

Pencil points to location where coils are subject to failures caused by dust and chemical deposits. The epoxy fills this area.

A substantial saving has been realized by Pittsburgh Coke and Chemical Co. in the maintenance of 15 motors which move coke conveyor belts and actuate chemical and water pumps. The motors, ranging from 3-60 hp., both enclosed fan-cooled and explosion-proof types, are subject to high moisture, intense dust, and chemical contamination in their operation. These conditions were grounding the windings, thus disabling the motors.

The manufacturing and repair division of Westinghouse Electric Corp. was called in to solve the problem. They applied a solventless epoxy protective encapsulation, Super Coilife, after rewinding.

Especially designed for motors which must operate in high humidity or chemical-laden atmosphere, Super Coilife has a low viscosity which enables it to penetrate the interstices of the windings. Produced by the Benolite plant of Westinghouse's Micarta Division, the epoxy is applied by a process that utilizes the correct thickness for each type and class of winding. The resultant finish should not crack or craze.

—The End

Reinforced plastics PR in RP

Edited by: HARRY T. DOUGLAS*

Having recently joined the already swollen ranks of reinforced plastics consultants, I would like to review my 12 years in the field in the next few columns, sharing some of my experiences which may be of interest.

The first is Public Relations. I have always been surprised at the generally poor quality of public relations efforts in our field—that is, by the molders and fabricators. Material suppliers do a good job, employing a public relations department, an outside public relations firm, or a combination of the two. I have been fortunate in having worked for the past 5-6 years with one of the more skillful and aggressive firms in public relations work and can attest to the effectiveness of this form of communication.

The dictionary defines public relations as "those functions of an enterprise, organization, etc., that acquaint the general public with its activities, purposes, policies, and accomplishments." The definition of publicity is very much akin to this and I, for one, have never seen a clear difference between the two. By whatever name, a public relations program, wisely used, works to the company's advantage. Sometimes using hardsell, sometimes softsell, its effectiveness can in some cases be measured in dollars and cents.

A busy editor never really has enough time. He is continually swamped by announcements of new materials, equipment, products, and company literature —often poorly written and accompanied by poor or un-usable photos. The advantage of professionally-prepared, pre-edited news releases accompanied by reproducible photos which "tell the story" cannot be over-stressed.

Professional public relations people are trained to present a pleasant image of the company to the public, whether they be customers, stockholders, competitors, or the public at large. The continual appearance in print of news items about any company invariably leads to the acceptance of that firm as a leader in its field. Its name becomes known.

A good public relations firm can also offer valuable aid in such allied projects as the preparation of brochures, stockholders letters and reports, sales information, technical paper preparation, and even the handling of displays, conventions, and trade shows.

To any of my readers considering a public relations program, a word of advice. I have never seen a field where so many unqualified people want to get in the act. Everyone, from the top man down through the secretaries, feels he can do a better job at public relations than the professionals. Believe me, "t'aint so." Choose a professional public relations organization, outline your goals, establish your parameters—then, accept their advice. —THE END

* Executive Vice-President, Lunn Laminates, Inc., Huntington Station, New York.

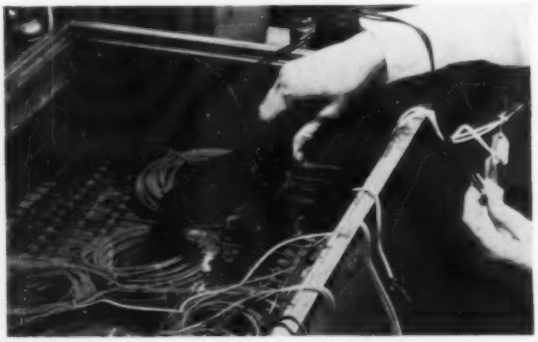
Drying polyethylene sheathing compound prior to extrusion

(Cont'd. from page 44)

Bibliography

1. J. F. Carr, E. I. du Pont de Nemours & Co., Washington Works Central Laboratory; unpublished bulletin.
2. International Critical Tables, Vol. II; First Edition.
3. J. Danaczko, Western Electric Co., Hawthorne Station, Chicago; unpublished report.
4. W. L. Badger and J. T. Banchero—"Introduction to Chemical Engineering," Chapter 10.
5. Perry's "Chemical Engineers Handbook," Third Edition, Chapter 13.
6. Designed and Furnished by C. H. Whitlock Associates.

—THE END



Ameripol high density polyethylene, a product of Goodrich-Gulf Chemicals, Inc., is suitable for wire and cable shielding.

Consultant's column

Edited by: DR. S. S. STIVALA*

Question: I am experimenting with various types of support for a very thin, brittle veneer used as a decorative material. The support, in panel sizes from 4 x 4 inches to 8 x 10 inches, should be 3/16-5/16 inch thick. Base materials of the support are granulated pumice and asbestos fibers (bound and pressed together). I need a binder to make the support rigid and which would neither shrink nor expand. What plastic materials should I try?

Answer: Your problem appears similar to the one involved in making structural particle board. Here, wood particles are combined with liquid or solid resin binders (usually 5-10% the weight of the wood) to form a premix which is formed and cured with heat and pressure. You could use these same binders, though perhaps with a higher resin content.

Urea formaldehyde binders tolerate a high degree of extension with fillers and cure over a wide temperature range, though best results are obtained at the elevated temperatures used in hot-press operations. Melamines resist drastic exterior rise, e.g., boiling water. For economy, combine 50-50 with urea and still obtain higher strength than with urea alone.

Phenolic and resorcinol resins are also excellent binding agents and the latter, though more expensive, is fungus-proof and unaffected by boiling water. For reasons of economy, they are usually blended with the phenolics.

All aldehyde resins would combine with dried pumice and asbestos to form a stable premix which could be kept at room temperature for several weeks. Dimensional stability of the supports will depend largely on exterior use, but should be good under normal conditions.

Question: Are there plastic pipes which resist oil and have high strength?

Answer: Yes, cellulose acetate-butyrate pipe and globe valves have been used successfully in low pressure, low temperature lines in some oil fields. It resists sour crude oil, earth, electrolytic action, and salt water —all normally encountered in oil production. It will not, however, resist certain solvents and strong alkalis. Unplasticized PVC has been used to replace metals in plumbing and oil well lines. It is resistant to many solvents (not including ketones and halogenated solvents), acids, alkalis, and some oxidizing agents.

Question: I understand that nylon has been used for artificial arteries in medicine. Have silicones ever been employed in similar applications?

Answer: Not to my knowledge. Silicone valves have been used with some success to by-pass defective aortic valves in human hearts.

Question: I have been experimenting with epoxy, phenolic, and unsaturated polyesters for electrical potting and encapsulation. What other resins might I try?

Answer: Polyurethanes, polysulfide-epoxy, and silicone resins provide good electrical characteristics combined with good impact strength. Electronic units have been potted successfully with room-temperature curing silicones. Transformers encapsulated in silicone were shown to have good mechanical and dielectric protection at temperatures above 200° C. —THE END

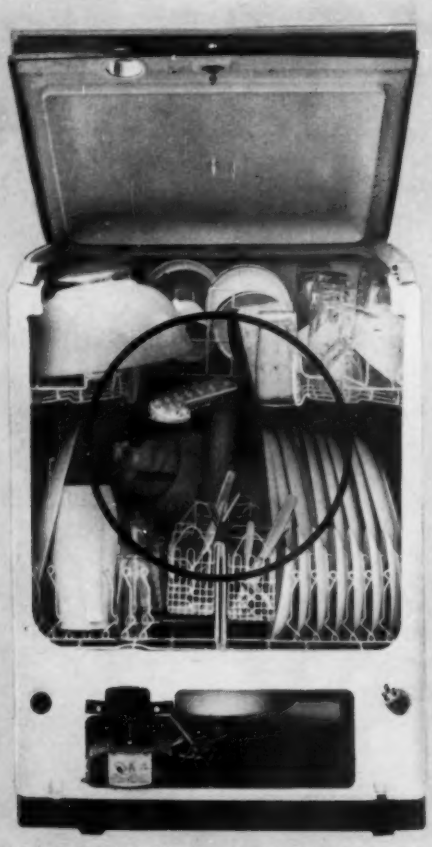
* Ass't. Professor, Stevens Institute of Technology, Dept. of Chemistry & Chemical Engrg., Hoboken, N.J.
* Plastics Engineering Consultant, S & S Engineering Associates, 280 Midland Ave., Saddle Brook, N. J.

HERCULES Plastics Hi-lites

Never Before in Plastics

Three pioneering designs in diverse markets point up the versatility of Pro-fax® polypropylene.

It goes without saying that in big ticket items, producers can't gamble on any part designed to play a key functional role. Whatever material they may plan to use they test it exhaustively, especially if it is plastic. These are not gadgets or novelties, but top-flight, high-quality merchandise. Pro-fax had to be good to even merit evaluation in such big, hard-to-do jobs. The fact that it won them all over all other materials points to a range and depth of performance no other thermoplastic can match. Never before in plastics . . . and never were the jobs done so well: functionally, esthetically, and economically.

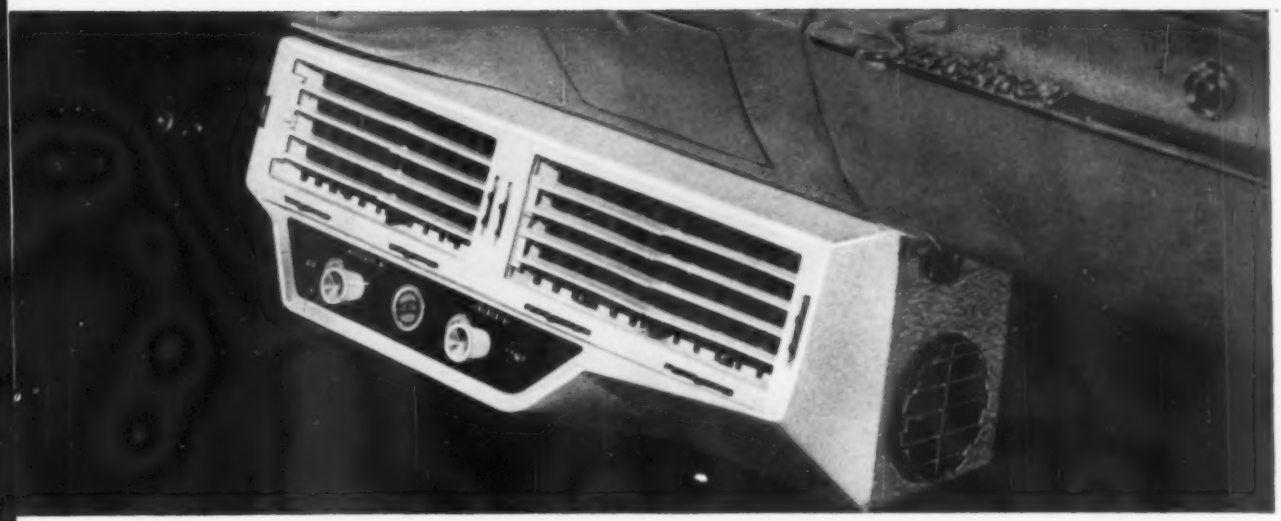


Molded by Industrial Molding Corporation, Culver City, California. Tubing extruded by Plastic Process Company, Los Angeles, California.

The heart of any automatic dishwasher is the water distribution system which provides the washing and rinsing action. Waste King uses Pro-fax for the unique rotating Z-arm of its new Universal dishwasher to provide improved washing action, increased capacity, and permit genuine "random loading." In operation a powerful pump forces water through scientifically located openings on the rotating arm into a spray which reaches into all corners of both the upper and lower baskets. Dishes, silverware, and pans are thoroughly washed and rinsed, regardless of their position in the machine.

Here's a job that makes real demands on a thermoplastic. Heat and stain-resistant, immune to stress-cracking from detergent attack, and possessed of the structural strength required to withstand the centrifugal forces set up by the rotating action, Pro-fax met every requirement.

Z-arm of Waste King dishwasher is constructed from injection-molded Pro-fax parts welded together to form this complex unit. Its through-and-through color can't wear off, rust or corrode.



FUNCTION AND ECONOMY BOTH HINGE ON PRO-FAX

The hinged deflectors for this new auto air-conditioner are all molded with Pro-fax, in a design which replaces many metal parts with a few attractive, durable plastic components. The unique ability of Pro-fax to replace a conventional metal assembly with an integrally molded hinge enabled Eaton Manufacturing Company to cut over-all costs more than 65% and at the same time achieve a weight saving of more than 90%. The completed Pro-fax assembly won't rattle or squeak, requires no lubrication, and has a glossy surface finish with high resistance to grease, oil, and ultraviolet light.

More and more new product designs such as this hinge won the selection of Pro-fax for improved function and reduced manufacturing costs.

Molded by Port Erie Plastics, Erie, Pennsylvania, for Eaton Manufacturing Company, Cleveland, Ohio.

FOR THE FIRST TIME . . . INJECTION MOLDED LUGGAGE

In luggage, too, Pro-fax® now does a job no material ever handled so well. Sears describes its new line of FORECAST luggage, injection molded with Titanite (*Hercules Pro-fax*), "the greatest step forward in luggage since leather." And for several good reasons. Extensively pre-tested before marketing by the world's largest merchandisers, FORECAST luggage, with exclusive Titanite shell, survived 2,000 tumbles in a mechanical package testing wheel (equivalent to a lifetime of use) where all other types failed after going only 1/5 the number of turns in the tumbler. It survived 500,000 miles of actual travel-testing with but a few scuff marks which were readily removed. One of the lightest molded cases available, its owners will recover its initial cost in savings in air travel excess weight charges. The excellent chemical resistance of Pro-fax makes it virtually immune to staining. Here's luggage you can scrub in the tub after travel dirt accumulates, and restore to its original rich, attractive finish.

Molded with a special formulation of high impact Pro-fax, it is strong, tough and resilient. Aptly named FORECAST, it's your first look at what will soon be the new look in many product lines where large shapes, injection molded with Pro-fax, will serve to bring new functionality and merchandising values to industrial and consumer goods.

Molded by Amos Molded Plastics, Edinburg, Indiana, for Sardis Luggage, Sardis, Mississippi. Exclusively distributed by Sears, Roebuck and Company, and available now in the Sears catalog and selected retail stores throughout the nation.

HERCULES POWDER COMPANY
INCORPORATED
Hercules Tower, 910 Market Street, Wilmington 99, Delaware

THREE NEW MATERIALS FOR THE PLASTIC INDUSTRY

HI-FAX® HIGH-DENSITY POLYETHYLENE • PRO-FAX® POLYPROPYLENE • PENTON® CHLORINATED POLYETHER

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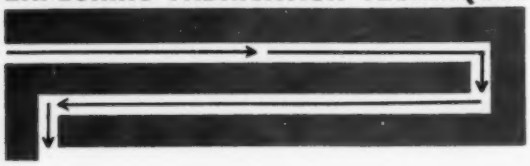
CP60-17

PLASTICS TECHNOLOGY
EXPLORING FABRICATION TECHNIQUES



By L. J. ZUKOR, *ENGINEERING EDITOR*

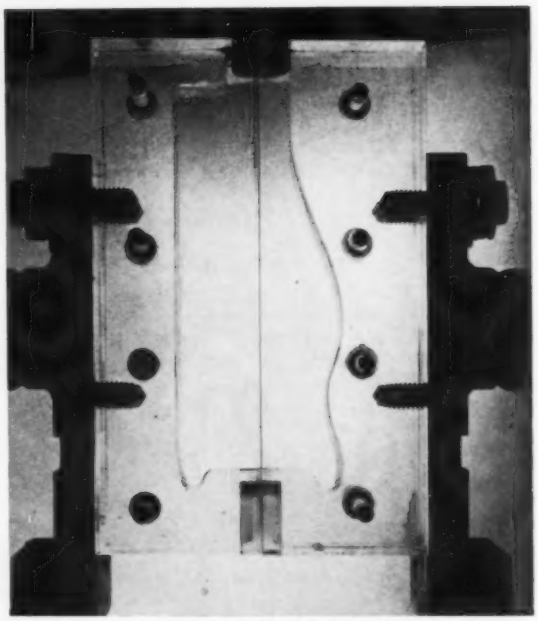
Blow Molding

Everyone in blow molding has wished at one time or another that he could see what was taking place inside a closed mold. If man were equipped with X-ray vision, it would be easy to determine the exact locations for mold vents, ways to cool blow-molded parts more uniformly, and see why and how certain surface defects happen.

Because we are not endowed with unique sight, we can only approximate happenings by deduction and elimination, as when an experienced operator determines what adjustments or repairs must be made on a mold after examining a rejected part. When the reject is an incompleted part, two things immediately occur to him—increase the blowing pressure and, if this doesn't work, vent the mold in the area of the part which was not completely formed.

His experience might also tell him when and where to apply vacuum for drawing a reverse configuration into contact with the mold surface, i.e., the finger holes in a toy bowling ball. This is "know-how," and in molding

Boston-round mold.



Dual-shaped mold.

circles it serves its purpose well on simple, symmetrical, and less critical objects. But, when objects are assymmetrical, have certain undercut features, or are high-production, critical moldings (such as detergent and aerosol bottles), it becomes imperative that a more concrete means be used to determine whether or not a mold will produce a perfect part before the production run is started.

Bill Lewing of Du Pont was also curious about the inner workings of a blow mold, and was able to build and experiment with transparent molds at the Chestnut Run Laboratories. I attended a preview showing of his motion picture on blow molding taken with a high speed motion picture camera. Operations took place inside two different acrylic molds. The first, was a 5¼-inch high by 1¾-inch diameter Boston round; the other, similarly dimensioned, had a composite shape. One-half of the latter is machined to a square shouldered rectangular form, and the other half had the shape of a bellied wine bottle. The shape of its bottom was that of a champagne bottle. This inverted type of bottom is generally used when contents are pressurized, otherwise pressure would bulge the bottom and prevent its sitting flat on an even surface.

To slow the motion for detailed study, the sequences were shot at an average speed of 50 feet/sec. and projected at normal showing speed of 16 frames/sec. or

4.75 inches/sec. Action occurring in 0.5 second was slowed down in projection to about 63 seconds. Blowing times shown in the diagrams were calculated by relating the number of frames of action to the film speed. Exact film speed was obtained from timing blips recorded on the film by the camera.

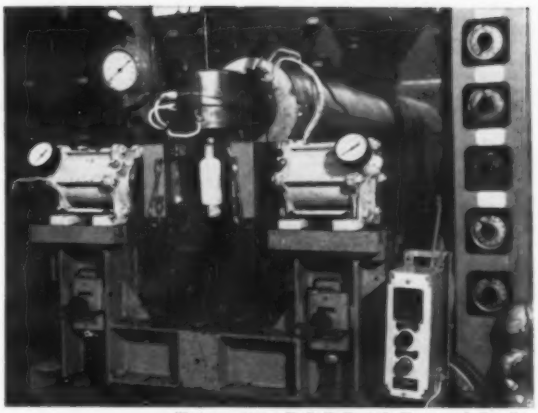
Test results showed that the blow pattern remained constant for each model configuration. Changes in blow pressure and resin temperature (melt viscosity) had no effect on the blow pattern. For polyethylene, the former was varied from 25 to 100 pasi., and the latter from 375° to 395° F.

The bottom perimeter is generally the last place to be filled. In cylindrical shapes, shoulders as well as bottoms are major areas of trapped air. Also noted in the motion picture, was the action of the bottom weld tab. Here, the material, wedged between the mold halves, holds the mold slightly ajar forming a built-in vent. This explains why entrapped air blemishes are commonly seen in shoulder areas but seldom in the bottom of bottles.

The pattern of filling showed that a sharp or narrowly elongated shoulder or bottom could result in excessive stretching (thinning) of the polymer at these points. Stretching is more than just a function of the distance in which a parison is expanded; it also is affected by the difference in time in which each portion of the molded part freezes to a hardened shape. As the parison approaches a corner, that portion touching the wall of the chilled mold first begins to freeze, allowing the remainder of the still hot polymer to be stretched even more.

An increase in blowing pressure decreases blowing time. For example, increasing from 25 psi. to 100 psi. reduces the blow time (in polyethylene) about 40%. An even cooling rate is desirable to assure good surface characteristics and depends on the shortness of blow time. It follows, therefore, that the highest allowable blowing pressures should be used.

Further observations of the high speed film frames indicated that it takes considerably longer to fill the bottom corners of the champagne bottle. When corners are too deep, inadequate filling or excessive thinning results. Mold pinch-off affects the strength of the weld seam. Knife-edged pinch-offs form weak, shallow, "V" notched welds. Best results are obtained for bottles and other containers when the hot polymer is pinched between flat surfaces. Edges with 0.020-0.120 inch lands, from which an included angle of 15-18° extends, will form an internally beaded seam. This type of pinch-off causes a little of the viscous polymer to be forced into the mold as it closes, thus forming the bottom closure.

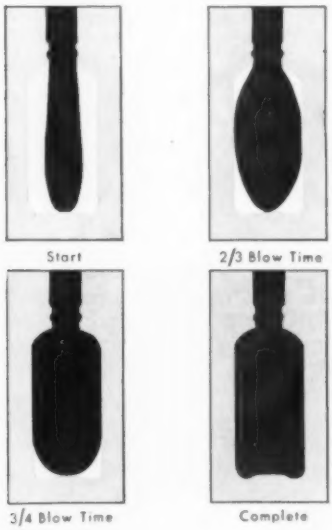


Photos courtesy: E. I. DuPont de Nemours & Co., Inc.
Blow molding test equipment.

Bill Lewing noted the effect of excessive blow-delay-time on finished bottles. When a mold closes on a parison, the molten tube begins to sag under its own weight, the upper portion streching slightly while the bottom bells out. If air is introduced immediately, no ill effect occurs. But, when the interval between mold closing and blowing is too long, the parison continues to sag toward one wall. Then, when pressure is introduced, this side reaches the wall first and freezes. Since this portion of the tube has a shorter distance to travel than its opposite side, the result will be a thick spot in the wall of the finished bottle.

—THE END

BLOW PATTERN - BOSTON ROUND



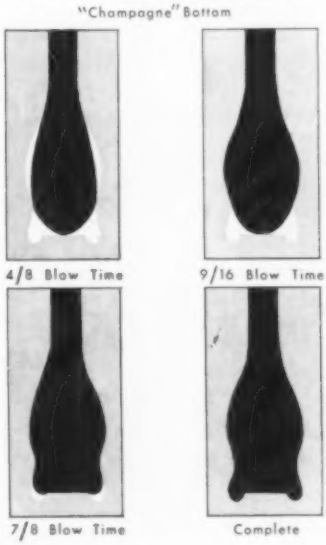
Polyethylene blow times (sec.)

Blow Pressure	Stock Temperature 335° F.	Stock Temperature 390° F.
25 psi.	0.50, 0.50	0.57, 0.55
100 psi.	0.32	0.36, 0.21

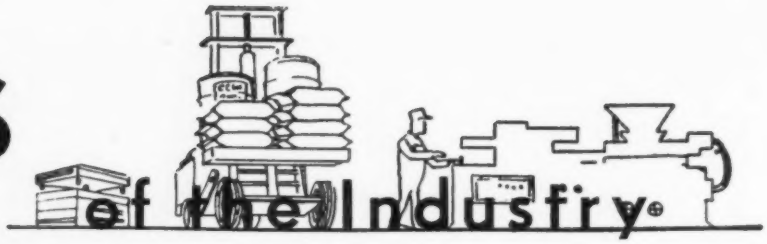
Delrin blow times (sec.)

Blow Pressure	Stock Temperature 375-380° F.	Stock Temperature 395-400° F.
25 psi.	0.25, 0.18	0.17, 0.16

BLOW PATTERN - CONTOURED SHAPE
"Champagne" Bottom



NEWS of the Industry



new plants, labs & additions

Conforming Matrix Corp. recently moved to a new plant at 830 New York Ave., Toledo, O.

Duval Industries, Inc., has consolidated all of its custom molding facilities in a recently completed plant at 120 Banks St., Winthrop, Mass.

Acme Resin Corp has opened a west coast office at 17417 Chatsworth St., Granada Hills, Calif. Main offices are located in Forest Park, Ill.

Nalge Co., Inc., is constructing an addition to its plant in Rochester, N. Y.

Beckman Instruments' Scientific & Process Instruments division has opened a Boston sales office at 12 Norfolk St., Cambridge.

Proman, Inc. has transferred headquarters from Grand Haven, Mich., to 1056 Home Ave., Akron, O. A research firm, Proman specializes in high-strength reinforced plastics.

Polymer Corp. has opened offices and a warehouse in Industrial Park, Rolling Meadows, Ill.

DuPont's major Zytel nylon resins have been established as safe for food handling and process applications by the Food and Drug Administration.

O'Sullivan Ruber Corp. has acquired Gulfstream Plastics, Inc., Hialeah, Fla., injection molding firm.

news from abroad

Imperial Chemical Industries, Ltd., has begun negotiations with the Soviet Union for licensing an inexpensive process of making caprolactam, the monomer for nylon 6. I.C.I. is also negotiating the sale of a polyethylene plant and know-how.

Chromos Werke, Zagreb, Yogoslavia opened that country's first polystyrene plant. Initial annual capacity of 420 tons is about one-fourth the domestic requirements.

Chemische Wereke Huls, West Germany, is now in commercial production of dodecanolactam, the base material for the new nylon 12. Properties superior to Perlon (nylon 6) and Rilsan (nylon 11) are claimed.

news from abroad

AviSun Corp. has concluded an agreement with Shin Nippon Chisso Hiryo, K.K., of Tokyo, to manufacture and market polypropylene resin, fiber and film in Japan. Construction of a 30-million lb/yr. plant begins immediately, with completion scheduled for 1962.

Dow Hellenic Chemical Industry, Ltd., is building a Stryon production plant at Lavrion, Greece. Completion is scheduled for late 1961.

business developments

Owens-Corning Fiberglas Corp. has formed a subsidiary, Owens-Corning Fiberglas International, S.A. George Cook III has been appointed president.

Laboratory Plasticware Fabricators of Kansas City, Mo., has set up extensive facilities for Teflon coating of metal, ceramic, and glass parts—on a production basis.

Herculite Laminating Corp., Newark, N. J., has initiated a plastic-fabric custom laminating service.

changes in ownership, new companies

National Vulcanized Fibre Co., Wilmington, has acquired Fisher Mfg. Co., Inc., of Hartwell, Ga. The latter firm supplies vulcanized fibers, fiberglass, and fiber-armored materials handling receptacles.

William A. Munkacsy, president of G. S. Plastics Co., has purchased full ownership of that Cleveland firm.

Federal Tool Corp., Lincolnwood, Ill., has merged with Proven Products, Inc., and Federal Premium Service, Inc., both of Skokie, Ill. The new organization, Fedco Corp., will operate the following divisions: Federal Housewares, Federal Tool & Die, Proven Products, and Federal Molding & Stamping.

market forecasts

Phillips Chemical Co. predicts that as much as six million pounds of high density polyethylene will be consumed this year by the four major U. S. car manufacturers. This new figure represents a 4.5-million pound increase.

Allied Chemical's Ernie Johnson predicts that the United States will turn out 157,000 plastic boats in 1961. He reports molding activity especially heavy throughout the midwest and west.

Names in the News

P. W. Perdriau

P. W. Perdriau, general manager of B. F. Goodrich aviation products division since 1956, has been named president of the company's Industrial Products Co. Mr. Perdriau has been with Goodrich since 1934. Before heading aviation products, he was director of employee relations.

Modern Plastic Machinery Corp. has announced for important appointments. **Frederick J. Maywald** is now vice president and general manager. **Leslie J. Kovach,** formerly president of Boston Plastic Machinery, Inc., has been named vice president in charge of blow molding. **Casper S. Gilbert** and **Bruno V. Menegus** are, respectively, sales manger and chief engineer.

Richard F. Brown

Union Carbide Chemicals Co. has appointed four vice presidents: **Richard F. Brown,** vice president—sales; **Robert L. Duncan,** vice president—product marketing; **Thomas R. Miller,** vice president—research and development; and **Arthur P. Moss,** vice president and works manager.

Union Carbide Plastics Co. has named **John Benedito,** vice president—special projects; and **Richard M. Joslin,** vice president—sales.

George M. Schau has been appointed general sales manager at Perry Plastics, Inc. He was associated with Erie Resistor Corp. for 25 years.

Three product managers have been named by Allied Chemical Corp.'s plastics division: **John J. Taylor,** polyethylene; **Stanley M. Mulder,** Plaskon phenolic resins; and **David W. Towler,** Halon fluorohalocarbon molding and extrusion compounds. Mr. Taylor, who has been with Allied since 1953, served on special assignment in Europe in 1958. Mr. Mulder and Mr. Towler have both served in various sales and technical positions with the company.

Fred Schneider and **Wendell Moyer, Jr.,** have joined Marbon Chemical Division, Borg-Warner Corp. as group leaders. Mr. Schneider, formerly associated with Firestone Plastics, will be in charge of plastic applications and evaluations. Dr. Moyer comes from Union Carbide Plastics Co. to handle exploratory research.

Jack R. Siegelbaum has been transferred from Reichhold Chemicals, Inc.'s chemical division, where he was product manager, to the plasticizer division. As product sales manager, he will be responsible for sales of plasticizer and other components to the vinyl industry and others.

Robert E. TenHoor

Robert E. TenHoor, who formerly headed the polymer chemicals section of Dow Chemical Co.'s technical service and development department, is now manager of a specially-organized urethane chemicals sales unit.

W. W. Clark has been promoted to special assistant to the general manager of Continental Oil Co.'s petrochemical department and assistant to the chairman of the board of Carlon Products, Inc., a Conoco affiliate. Formerly assistant director of Conoco's marketing research division, he will now act as liaison for Conoco with Carlon Products.

Charles K. Lawrence has been named assistant to the director of research and development of Allied Chemical Corp. With the company since 1928, he has held various supervisory positions in research and was named associate director of the nitrogen division's Hopewell, Va., laboratories in 1958.

James Eberhardt has been named plant manager for western operations of CTL Division, Studebaker-Packard Corp. Mr. Eberhardt has served as a design engineer for Aerojet Corp. and has held sales and engineering positions with American Reinforced Plastics.

Ralph M. Winters has been advanced to technical service manager—film at Avi-Sun Corp. He formerly was employed by American Viscose Corp.

Herman Reffe has left Electro Tech Division of Sun Chemical Co. to head up sales of Cordopreg-Mobaloy prepregs for Cordo Molding Products, Inc.

OBITUARY

Henry D. Randall died December 7 at his home in Annapolis, Md. He initiated formation of the plastics department for General Electric Co.

An electrical engineering graduate from Amherst, Mr. Randall started with General Electric in 1912, after ten years with Westinghouse. After his retirement in 1946 at age 65, he served Insulating Fabricators as sales manager and technical consultant for 15 years.

Benjamin H. Davis, founder of Davis-Standard Corp., has died.

Mr. Davis entered the plastic industry selling extrusion equipment. In 1948 he joined Standard Machinery Corp., and formed its sales agent, Davis-Standard Corp. He served as vice president in charge of engineering and sales for Standard Machinery, and vice president and director of the parent organization, Franklin Research and Development Corp. He designed much equipment for jacketing wire and cable processing plastic material.

Since his retirement in June 1959, Mr. Davis has acted as consultant for Standard Machinery and Davis-Standard Corp.

George H. Clark

George H. Clark, a former vice president of Formica Corp., died in Cincinnati, O., on December 30. With Formica since 1926, Mr. Clark had at various times served as chief engineer, vice president-engineering, and vice president-manufacturing.

Mr. Clark was born in Paris, Me., in 1890. He graduated in 1913 from M.I.T., where he remained to teach engineering. After a stint in the Navy during World War I, Mr. Clark was employed by Marine Hardware Co. and Waltham Watch Co. until joining Formica.

As vice president-engineering, he headed design and construction of the company's Evendale, O., laminating plant.

Mr. Clark served as a director of SPI from 1944-1951. He was president from 1947-1949, and chairman from 1949-1951.

New Materials

For more information check Readers' Service Card (p. 83)

Mold release agents

Non-silicone liquid mold release agent #5727 is available from Mitchell-Rand Mfg. Corp. It is intended for use in release laminates, casting, and moldings of polyester, epoxy, and polyurethane resins from non-porous surfaces. This xylol-cut product can be applied by spraying, brushing, or dipping. It can be removed from plastics, when necessary, by washing with a solvent such as xylol or with a water solution of household detergent.

Readers' Service Item 1

A SILICONE SOLUTION for release in compression, injection, and lay-up molding and slip casting has been designated XS-4030 by the silicone products department of General Electric Co. The solution, with a viscosity of five centistokes, contains 5% silicone in a petroleum solvent, and can be brushed, swabbed, or sprayed on surfaces.

Readers' Service Item 2

Aerosol release agent

Part Lube 100, a universal release agent and mold lubricant, is available from British Industries Corp. This dispersion of lubricating waxes reportedly is economical, since it will remain on the mold surface for several cycles.

Readers' Service Item 3

Stannous octoate catalyst

A stabilized stannous octoate catalyst for urethane foams is specifically designed to minimize the loss of catalystic activity when the catalyst is exposed to air. Witco Chemical Co., Inc., recommends the use of Fomrez C-2 in conjunction with other catalysts for the production of one-shot polyether flexible foams. This clear yellow liquid with a specific gravity of 1.25 has a stannous tin content 94.3% of total tin content. Metal content is 28.1%.

Readers' Service Item 4

High impact rigid vinyl

Bakelite VCA-3606 is a rigid vinyl material formulated for luminous ceiling diffuser and other lighting fixture applications by Union Carbide Plastics Co. In addition to the light and dimensional stability and non-support of combustion properties possessed by other Bakelite diffusion sheeting, VCA-3606 has unusual resistance to damage incurred during shipping, installation, and cleaning than some other materials.

This calendered rigid sheet is available in translucent colors in thickness from seven mils up. Specifications follow.

Heat distortion temperature at 264 psi., ° C.	62
Specific heat, cal/gm./° C.	0.23
Thermal conductivity, cal/cm. sec./° C.	37×10^{-3}
Coefficient of thermal expansion, linear, /° C.	
Below 55–65° C., avg.	69×10^{-6}
Above 55–65° C., avg.	186×10^{-6}
Tensile strength, psi	8000
Elongation, %	20
Modulus of elasticity in tension, psi	380,000
Flexural strength, psi.	11,000
Impact resistance, Impactometer, ft./sec., MD	<75
TD	67.0
Impact resistance, Izod, ft. lbs./in. notch	1.2
Specific gravity	1.3

Readers' Service Item 5

Injection molding polyethylene

Spencer Chemical Co. has developed a polyethylene resin for injection molding. Said to be unusually resistant to environmental stress cracking, it is recommended for housewares, containers, closures, pouring spouts, and other parts in which stress crack resistance is important.

Some significant properties of this resin are:

Bulk factor	1.7
Melt index	1.4
Density	0.91
Stress crack resistance, 50° F., hours	400+
Tensile strength, psi	1850
Yield point, psi.	1350
Elongation, %	630
Stiffness in flexure, psi.	13,100
Impact strength, Izod, 73° F., ft. lb./in.	18.30
Hardness, Shore D	45
Brittleness temperature, ° F.	< −76
Softening point, Vicat, ° F.	205

Readers' Service Item 6

Phthalate ester plasticizer

Mercury Chemical Corp. is offering a proprietary phthalate ester plasticizer prepared from a mixture of C_6, C_8, and C_{10} alcohols. Plasticizer 7 can be used where economic considerations are of prime importance. It is reported to have good solvating properties and tolerance for secondary hydrocarbon plasticizers. Therefore, it increases processing speeds at the same time it allows further formulation modifications. Specific gravity of this amber material is 1.041. Typical performance data include:

Modulus, 100% elongation, psi	1550
Ultimate elongation, %	310
Hardness, Shore A	75
Low temperature flexibility, °C	−13
Water loss, %	0.61
Volatility loss, %	4.5

Readers' Service Item 7

Improved clear epoxy

Improvements in its Maraglas crystal clear epoxy resin #655 have been disclosed by Marblette Corp. Combining Maraglas resin with Marblette hardener #555 reported speeds curing cycle. Temperatures up to 180° F. can be used for curing relatively small objects. Rockwell hardness M50-M100 should be attainable.

Readers' Service Item 8

Enamels for polystyrene

A polystyrene coating material, G 7246E, has been developed expressly for use on polystyrene plastics by Gordon-Lacey Chemical Products Co., Inc. It reportedly will not craze the polystyrene, no matter how heavy a coat is applied. Adhesion, color, and color retention are claimed to be excellent. Besides being suitable for normal decorative use, it can be used as an undercoat for depositing silver and metallized coatings.

Readers' Service Item 9

High temperature urethanes

Thanks to polymethylene polyphenylisocyanate (PAPI), Carwin Co. has been able to develop rigid urethane foams noteworthy for retention of compressive strength at high temperatures. These foams are claimed to retain 45-65% of their room temperature compressive strength at 600° F., and to retain dimensions to 450° F. They are infusible, and after carbonization at 900-1,000° F., they pass directly from the solid to the gaseous state.

Foams can be supplied in densities of 3-40 pounds per cubic foot. One formulation is Carthane 1008, a two-component, water-blown system. Like others in supply, it requires post curing for development of optimal properties. Foams of rapid reacting 1008 retain much mechanical strength despite severe temperatures. Coefficient of thermal conductivity (K factor) of three-pound per cubic foot foam at 325° F. is reported to be 0.26.

Another foam, Carthane 1003 has identical properties with one exception. It

has been modified for extended pot life. After contents are mixed, it takes 5-10 minutes before the foam begins to rise.

Compression set of a foam of 10-pound density is 4.9% at 158° F. This foam has a compressive strength (at 10% deflection) of 65 psi. at room temperature. Compressive strength falls to 175 psi. at 325° F., and to 110 psi. at 600° F. Tensile strength of 10 pound per cubic foot foam is 180 psi. at room temperature; 110 psi. at 400° F.

Readers' Service Item 10

High temperature materials

Radiation Applications, Inc., is making Raiseal adhesives, sealants, and encapsulants developed especially for the missile, electronics, and aircraft industries. Three compounds are now being offered.

Raiseal 100 is elastomeric material for use in pressure and weather sealing at temperatures from -100° F. to over 700° F. Raiseal 200, a one-part putty compound for sealing and encapsulating at temperatures in excess of 800° F., retains moderate strength at these temperatures. The third material, Raiseal 300, is a two-part rigid adhesive for structural use over 1,000° F. It is claimed to have greater impact resistance and flexibility than phenolic or epoxy adhesives, and less brittleness than comparable ceramic adhesives.

Readers' Service Item 11

Linear polyethylenes

Dow Chemical Co. has introduced two high density polyethylene formulations, Q-917.7 and Q-917.8. Designed for injection molding and film applications, the resins may be used in housewares, industrial containers, toys, film overwrap, tape backing, etc. Density is 0.957.

Typical physical properties of the two resins are:

	Q-917.7	Q-917.8
Melt index	3.5	5.5
Tensile strength at yield, psi	3,500	3,600
Tensile strength at break, psi	2,200	2,100
Elongation at break, %	400	200
Tensile modulus, psi	130,000	135,000
Impact strength, ft. lbs./in. notch	2.5	1.5
Low temperature brittleness, °C.	−80	−80
Hardness, Shore D	60	60
Vicat shoftening temperature, °F.	258	260
Mold shrinkage, in./in.	0.025–0.045	0.025–0.045

Readers' Service Item 12

Low and medium-density PE

Fifteen formulations of Dylan low and medium-density polyethylene have been made available commercially by the plastics division of Koppers Co., Inc. Thirteen of the formulations are supplied in natural color, and two in black.

Dylan 1350 is recommended for fast flow injection molding; 2012 and 2020 where additional stiffness is required for molded parts; 2025, 2027, and 2029 for clear films by blown film extrusion, intended primarily for packaging uses where clarity and high impact strength are desirable; 2038 for clear films by chill-roll extrusion.

For production of items such as shower curtains and tablecloths, films of Dylan 2046 and 3046 show desirable translucency and lack of gloss.

2040, 2050, and 4042 are injection molding grades tailored for production of can and bottle closures and for pressure buttons on aerosol cans. 3103 is recommended for injection molding where quick mold release is important.

Of the two black resins, 1014-A is a master batch for blending with natural resins to provide black film, pipe, or moldings; 2014 is a low-density pipe resin.

Readers' Service Item 13

Also Worth Mentioning

☐ Poly-Phen L-118, a phenol formaldehyde resin designed for improving the resistance of polyvinyl acetate to high temperature, water, and several solvents, has been introduced by National Polychemicals, Inc. This reddish-brown liquid is also claimed to reinforce the physical properties of the polymer and reduce cold flow characteristics. It can be used alone for many bonding and impregnating operations, and shows promise of being able to modify other types of water-dispersed polymeric systems.

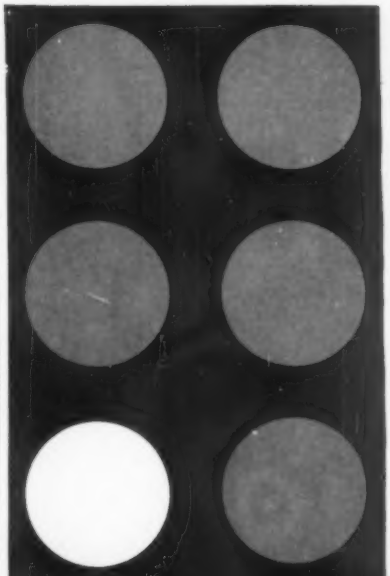
Readers' Service Item 14

☐ Millmaster Chemical Corp. is acting as sales agent for Liquithane, a eutectic liquid mixture of ethyl and methyl urethanes produced by Berkeley Chemical Corp. The compound is useful as a solvent for organic compounds and as a raw material for higher molecular weight carbamates, chemicals, and polymers. This colorless liquid consisting of about 52% ethyl urethane and 48% methyl urethane boils at 90° C. at 20 mm. and 177° C. at 760 mm. Equilibrium melting point is 13-17° C. It is miscible with water and most organic liquids with the exception of saturated aliphatic hydrocarbons.

Readers' Service Item 15

☐ Two polyvinyl chloride stabilizers have been developed by Nopco Chemical Co.'s Metasap Division. Metasap AB-62, a cadmium-barium liquid, is reported to provide optimum balance between initial color and long term heat stability in film and sheeting, extruding and molding compounds, and plastisols and organosols. AC-75 is a barium-zinc liquid for use in stabilization of plastisols or highly filled pigmented stocks when freedom from sulfur stain is required.

Readers' Service Item 16



DIFFERENT?

Let's assume that these circles represent your product and five competitive products. There may be no significant difference in design, concept, operation, or construction, yet, one catches the eye more than the others. We've represented this stand-out product by the white circle —it's not really different, it just looks different.

If your product had this ability to capture more attention than competitive products, wouldn't your sales benefit? Of course. And, you can build this type of difference right into your product. Here's how:

Nacromer® SYNTHETIC PEARL ESSENCE

MURANO®

SYNTHETIC PEARL IN COLORS

Both of these materials will complement your product designs with luster effects and a depth of color impossible to achieve with conventional dyes or pigments. With Murano, for example, you can obtain a multiple color play which verges on the iridescent. They can be incorporated into plastics or used as a coating on almost any material.

Tell us the material you work with and we will gladly send you literature and samples.

•

THE MEARL CORPORATION

world's leading producers of pearl essence

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NEW YORK 17, NEW YORK

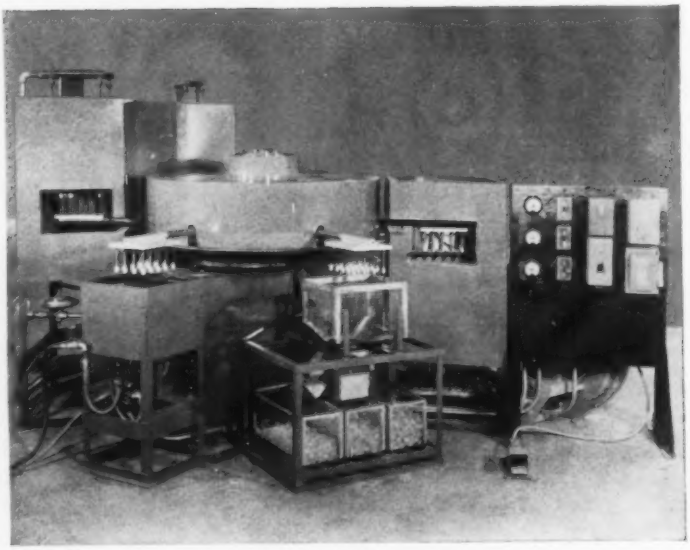
New Equipment For more information check Readers' Service Card (p. 83)

Rotary hot stamper

Rainville Co., Inc., is distributing an English-made rotary hot stamping machine Rainmark 220, capable of 3,600 stampings per hour. The 19-inch turntable is adjustable to six or 12 indexing stations. Drive is a $\frac{2}{3}$-hp., 220 volt, 3 phase motor.

Dimensions in inches are 42 by 38 by 59.

Readers' Service Item 21



Infra-red conveyor

An infra-red conveyor for heat conditioning, setting, and drying is now being marketed by Mercury Industries, Inc.

Materials placed on the aluminum alloy conveyor will pass through an oven adjustable up to 500° F. The controlled reflective heat is claimed to offer high production with economical operation. The conveyor may be cleaned with hot water or steam.

Characteristics of the equipment include vibrationless movement, variable speeds up to 100 fpm., reversible controls, and cleats for incline operations. Standard five-foot sections are available in heights and widths to meet any plant requirement.

Readers' Service Item 22

Automatic dipping machine

Akron Presform Mold Co. is marketing a fully automatic dipping machine, for use with vinyl plastisols, which can produce up to 12,000 items per hour. The six-station machine preheats, forms, dips, thermosets film, cools, strips, and sorts. The cycle takes from 36 seconds up. Speed is regulated by gages which are calibrated in seconds so that time and temperature can be set exactly.

Each form carrying plate holds up to 20 forms, and three different items can be produced simultaneously. All that the operator must do is fill the resin tank and remove boxes of sorted items.

Standing five feet high, the machine requires floor space of eight by ten feet. Typical of the products it produces are small bulbs, nipples, pen sacs, handlebar grips, and gloves.

Readers' Service Item 23

Model 300 A vacuum former.

Production vacuum former

A vacuum former intended for both short and long run blister packaging is on the market. Plast-O-Craft Co., Inc., is the manufacturer.

The former may be sheet or roll fed polyethylene, styrene, acetate, butyrate, and extruded acrylics. Controls, heater, and power vacuum pump are supplied with purchase. Plate size, 15 by 20 inches, is claimed to be adequate to form 20 full length tooth brush blisters simultaneously.

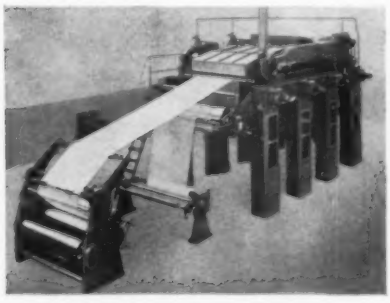
Readers' Service Item 24

Printing press for plastics

A rotogravure press for printing extensible plastics can be ordered from Cerutti Presses of America, Inc. The Polyroto press will print from one to eight colors on polyethylene, PVC, and similar film and sheet ranging in thickness from 0.00236 to 0.020 inch. Speeds run up to 200 fpm.

The press allows time for drying between color runs and before rewinding. A two-roll tunrover unwind and a surface rewind with spindles for six rolls speed roll changes.

Three standard web width—48, 60, and 72 inches—are available, with a repeat range of 18½-86½ inches.



Cerutti rotogravure press.

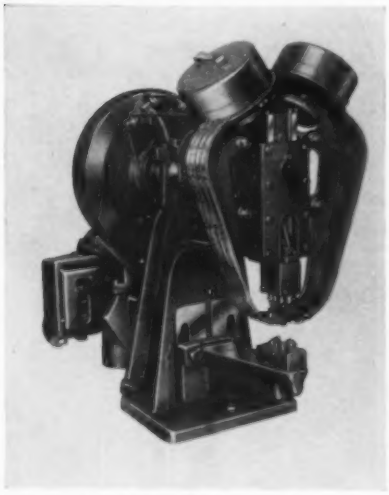
Readers' Service Item 25

Eyeleting machine

United Shoe Machinery Corp. is producing a modified eyeleting machine for making feed-throughs in plastic insulating terminal board. Model F eyeleting machine is being used to make six pairs of irregularly spaced eyelets in a 3/16-inch thick terminal board, approximately 2½ by 1½ inches.

The equipment was developed by United, who also supplies the eyelets. Automation was achieved by accurate alignment of a special setting bar and by a rigid frame which provides uniform pressure on all six twin contact points.

Other models of the machine can be used for inserting terminals and connectors in printed circuitry.

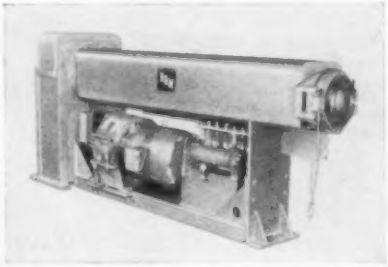


Model F eyeleting machine.

Readers' Service Item 26

Compactly designed extruders

Space-saving design is the outstanding feature of the 3½, 4½, and 6 inch Pacemaker extruders. National Rubber Machinery Co. builds the extruders in modules. Thus, drive gear ratio, thrust bearing capacity, drive horsepower, screw type, and heating-cooling mechanism can be selected for the requirements of a particular material.



Pacemaker extruder with Tuck-Under drive.

To conserve floor space, motor and speed control are placed under the barrel. The Tuck-Under drive means that production increases up to 350% can be realized by installing a 4½-inch Pacemaker in the same space required by a 2½-inch extruder with in-line drive.

Temp-Flo closed-circuit liquid cooling, an optional feature, is a system employing a coolant pump to circulate liquid through individual coils in each barrel zone and through a heat exchanger into the reservoir. Air cooling can also be supplied. LD ratio can be 20:1 or 24:1. Ratios of helical gears are standard 17.5:1 and 25:1.

Readers' Service Item 27

Extrusion instruments

Wheelco Instruments Division of Barber-Colman Co. has introduced a pressure indicator and a combination pressure and temperature recorder.

The Series 400 pressure indicator, a measuring system and DC power supply in a single unit, is useful for the pressure measurement of viscous liquids at elevated temperatures. In an extruder, this is usually accomplished before or after the breaker plate. Measurements between the breaker plate and screw indicate mixing efficiency and screen plugging, while die pressure, a measure of output, can be determined just below the breaker plate.

The two indicator models available, 430A and 430B, have different power outputs for use with different transducers. Model 430A will work with Dynisco and CEC transducers; model 430B with Taber and Norwood transducers. Both models have standard scales of 0-10,000 and 0-5,000 psi. On each linear scale, a full scale span in millivolts is 4.9-5.5.

The Series 8000 electronic potentiometer recorder is also designed for extruders. With a constant voltage source, it will record one or more points of pressure and up to 23 points of pressure. Standard temperature range is 0-800°F. Independent pressure range is 0-10,000 psi.

Readers' Service Item 28

Izod notch cutter

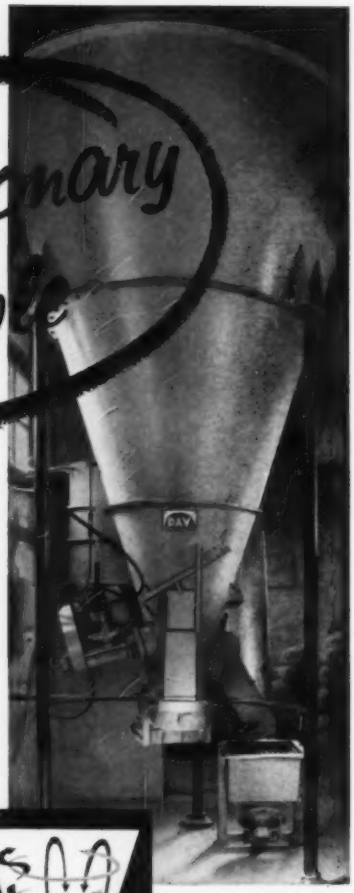
Testing Machines, Inc., has announced a cutter which notches up to five Izod specimens simultaneously.

Samples are automatically positioned in the cutter for proper depth and position of notch. By moving a lever, the samples are notched. Depth of cut is automatically registered on a dial indicator.

TMI Izod specimen notcher.

Readers' Service Item 29

Revolutionary Principle of DAY NAUTA MIXER*



Assures
HIGHEST Mixing Accuracy in SHORTEST Mixing Time

Compare these Unequalled Features:

• **HIGHEST MIXING ACCURACY** — Consistently superior performance in plants here and abroad prove the Day Nauta Mixer produces a greater degree of mixing accuracy in less time than any other known type of equipment.

• **LOWEST MIXING TIME**—Obtain a thorough mix in ½ to ⅓ the time of conventional mixers.

• **EASY ADDITION OF LIQUIDS** — Day "Microjet" device permits easy additions of molasses, fats, oils, vitamins, etc., to large amounts of batch. Insures complete homogeneity of mix and no lump formation.

• **STARTS UNDER FULL LOAD** — Mixing starts under full load as unique three-way mixing action immediately loosens the batch; prevents stalling.

• **LOW POWER CONSUMPTION**—A 5 hp. motor can mix a 4000 lb. load.

• **SANITARY DESIGN** — Continuous cone shape of container eliminates corners and crevices. The Day Nauta is quick and easy to clean.

*Mfd. under license from N. V. Nautamix, Haarlem, Holland—Patented U.S.A.

NEW THREE-WAY MIXING ACTION!

Three distinctive mixing actions (see diagram) give a quick, accurate mix. Batch is mixed and spiraled upward by mixing screw. At same time, screw orbits around inside wall of conical container, moving batch in a large, second spiral. Third action is a gravity action as material flows downward in central area of cone. All three actions converge at the bottom of the cone for a fast, intensive mix, with heat from friction practically eliminated.

The Day Nauta Mixer is built in a wide range of capacities to suit your requirements.

Send for new illustrated bulletin.

DAY

The **J. H. DAY** *Co.*
Division of The Cleveland Automatic Machine Company
QUALITY MIXING, BLENDING, MILLING AND SIFTING EQUIPMENT SINCE 1887
4956 BEECH STREET CINCINNATI 12, OHIO

Cylindrical Heating Tanks

Efficient, controlled heat for melting or heating plastics and other chemicals is the object of electrically heated cylindrical tanks and pots manufactured by Sta-Warm Electric Co. The units feature a blanket type element applied to the bottom and approximately 75% of the sides, providing evenly distributed heat at low watt density, maximum six watts per square inch. The units are claimed to heat compounds uniformly.

Sta-Warm tanks and pots are available in voltages of 115, 230, 460, or 550, single or three phase, 50 or 60 cycle. Tanks and housing are of electrically welded mild steel, but can be order to customer's specifications. Temperature range is 250-550° F., controlled by dial thermostats. Standard models are equipped with electrically heated and thermostatically controlled brass, wheel-type gate valve.

Readers' Service Item 30

Also Worth Mentioning—

☐ A left-to-right, air-operated, roll leaf attachment can be supplied on the Kensol 36T, 50, 60, or 110 presses supplied by Olsenmark Corp. Available in 6 by 8 inch or 5 x 12 inch sizes, the attachment has a one-inch diameter air cylinder, four-way air valve, on-off valve, and roller speed controls.

Readers' Service Item 31

☐ A two position, four way, poppet type, sub-base mounted air control valve is in production at Hoffman Valves. With basic one-inch capacity, the valve is available with ¾, 1, and 1¼ inch NPT ports. Moving parts are cushioned by replaceable resilient seals to prevent impact damage.

Readers' Service Item 32

☐ Controlling the temperature of electrically heated materials by regulating input power is the function of Model SPY 5064 Thermac developed by Research, Inc. It operates by continuously proportioning the output of two thyratrons from 3-95% of their rated power (40 amperes at voltages up to 600 volts). Adjustments for limiting rate of temperature rise and for adjusting proportional band width are provided.

Readers' Service Item 33

☐ A plug-in dial timer, reportedly very easy to replace, is recommended by Automatic Timing & Controls, Inc., for use in high production processing operations. Type 305 Atcotrol timer comes in a variety of dial ranges and power requirements in both AC and DC operation. A keyed guide pin assures safety and accuracy of installation.

Readers' Service Item 34

Plastics Applications

For more information check Readers' Service Card (p. 83)

Translucent garage doors

Sectional translucent overhead doors for industrial and commercial use are said to transmit enough light to cut down lighting cost and window installation. The doors are made by Frantz Mfg. Co. of its series 2600 Filuma fiberglass-reinforced panels. They are available in widths and heights up to 14 feet.

Readers' Service Item 41

The doll that clings

The "winkie" doll from Japan, which clings affectionately to the arms or legs of its owner, is now made in America from Firestone Plastics Co.'s Velon. The doll above is of an inflatable vinyl.

Readers' Service Item 42

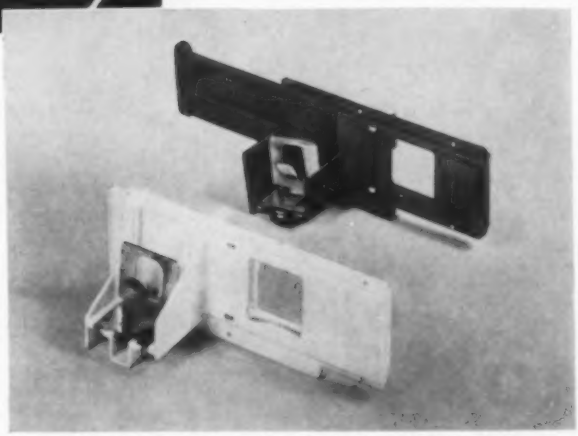
Acetal instrument housing

Dashboard instruments on the 1961 Chrysler Corp. Valiants are molded of Du Pont's Delrin acetal resin in one piece. The Delrin housing weighs only two pounds in contrast to the earlier zinc die cast housing, which weighed nine pounds.

The cluster housing is injection molded by Republic Corp.'s Consolidated Molded Products subsidiary on 200-ounce presses. Molded-in bosses accept six self-tapping steel studs for mounting the clusters to the dashboard frame. The clusters are sprayed with special primer, in preparation for the final coat of paint to match the car. They are installed by conventional assembly-line techniques.

According to Du Pont, Delrin helps to cut the weight, but not the strength, of this part.

Readers' Service Item 43



The white slide changer above is molded of Rohm & Haas Implex A acrylic by Contour Plastic Molding Co. for Mansfield Co. It is claimed to be superior in design and material to its darker colored phenolic predecessor.

Readers' Service Item 44

Dashew Datawriter 19-5.

Data imprinter

Accurate copying of source data is important in operation of new charge account banking programs, in which the retail customer uses a bank credit card to charge purchases he makes. The Dashew Datawriter automatically imprints data from the customer's credit card for later store and bank processing. The imprinter, with stainless steel body, has imprinter head, lever knobs, and end pieces of Tenite butyrate.

Operation of the imprinter is uncomplicated. The sales clerk slides the customer's bank credit card into place at the upper left of the Datawriter and sets the levers at the right for the amount of purchase. One stroke of the imprinter head imprints credit card information, store name and address, date, and amount of purchase. Data is then ready for input to processing systems or to tabulating or manual posting machines. The Datawriter can also be used for recording production control information, requisition data, etc.

Datawriter 19-5 is manufactured and marketed by Dashew Business Machines, Inc. Imprinter head, lever knobs, and end pieces are molded from Eastman's Tenite butyrate by Crescent Mold Engineering Corp.

Readers' Service Item 45

Alkyd computer parts

According to Alden Products Co., component bases and sockets molded from alkyd cut down-time for digital computers and other electronic machinery. The company is now molding bases and sockets from Plaskon alkyd 540, supplied by plastics and coal chemical division, Allied Chemical Corp.

Alkyd components for electronic machinery.

When reinforced with glass fiber, this alkyd has desirable strength, arc and insulation resistance, and dimensional stability. The non-interchangeable bases and sockets, without molded center bosses, are available in 20- and 11-pin design and 7- and 9-pin design for miniature and subminiature circuits.

Readers' Service Item 46

RP step ladder

Hopfeld Industrial Manufacturing Co. is marketing the Himco safety step ladder. The ladder, ten feet tall, weighs 39 pounds, and features a three-inch flat aluminum step imbedded in fiberglass-reinforced plastic.

Readers' Service Item 47

Coordinated kitchenware

The Estate line, a series of decorated utility items for the kitchen, is now available. Loma Industries, Inc., manufactures the appointments from aluminum and high density polyethylene.

Suitable for indoor and outdoor use, the containers are spacious. The breadbox accommodates three large loaves of bread. The canister set, on its own stand, holds two pounds of coffee, two pounds of tea, and five pounds each of flour and sugar. The covered cake server also has a compartment for a pie, and the paper dispenser, with serrated cutting edges, holds any size of wax paper, foil, and paper towels.

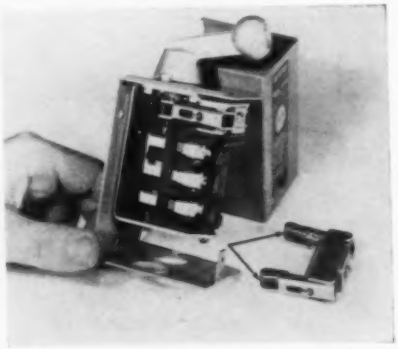
Estate canister set.

Readers' Service Item 48

Filled-nylon rollers

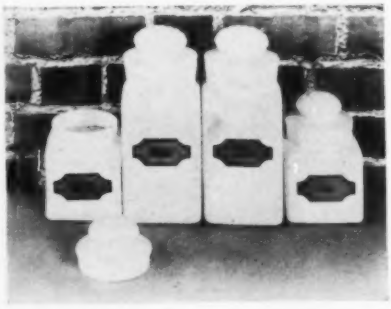
For the rollers on a cam follower which would operate for at least one million cycles, engineers at Allen-Bradley Co. selected Nylasint M4, a molybdenum disulfide-filled sintered nylon manufactured by Halex Corp. The cam follower roller is a part of the Bul 350 Style A switch, designed to break three lines in a variety of motors which it starts, stops, and reverses. Mounted on the tip of a spring-loaded follower arm, the roller receives impact and rolling and sliding friction when the switch is thrown and the star-wheel rotates.

If the roller wears, the switch may begin to jam. Therefore, a material which would not need replacement had to be selected. Nylasint M4 parts showed little wear at the conclusion of tests.



Allen-Bradley switch with filled nylon cam follower rollers.

Readers' Service Item 49



Mark-Tone polyethylene canister set.

Canister set

A four-piece canister set is molded of high density polyethylene for non-breakable attractiveness. Design and manufactured by Mark-Tone Plastics, Inc., the canisters have patterned lids which form airtight seals, keeping in fresh flavor.

Molded from W. R. Grace & Co.'s Grex, the canisters are unaffected by temperatures below zero to well above boiling point, and can be cleaned safely in automatic dishwashers. The two-pound coffee and tea containers measure 4⅜ by 4⅜ by 6¾ inches; four-pound sugar and flour canisters are 10¼ inches high.

Readers' Service Item 50

Modified cellulose for electroluminescence

An electroluminescent night light is one of the first applications of a modified cellulose fiber-forming material with the unusually high dielectric constant of 12.5.

The material, American Cyanamid Co's Cyanocel, is made by cyanoethylating a refined form of cellulose with acrylonitrile. The resulting resin can be cast into films or molded under high temperature and pressure. Besides the high dielectric constant, the material has a low dissipation factor, suggesting it for use

4½" EXTRA-LONG
FLOATING SCREW

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featuring
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GEAR REDUCER
with handy gear shift

West or Wheelco controls, standard wiring with US fuses, standard heaters, bearings, rotary unions, pressure gauges.

In addition to the floating screw control, the new 4½" Reifenhauser Extruder is available with a **high torque gear reducer and handy gear shift for instant change of the gear ratio.** Whether you need high screw speeds for a low viscosity material or low screw speed and high torque for a high viscosity material, simply use the handy gear shift and you are ready with a full 10:1 speed range for every extrusion application. **Screw sizes from 1¼" through 6"; Le/Dia. ratios 20:1 to 30:1. Packaged installations for film, sheet, monofilaments and biaxially oriented pipe.** Write for full information.

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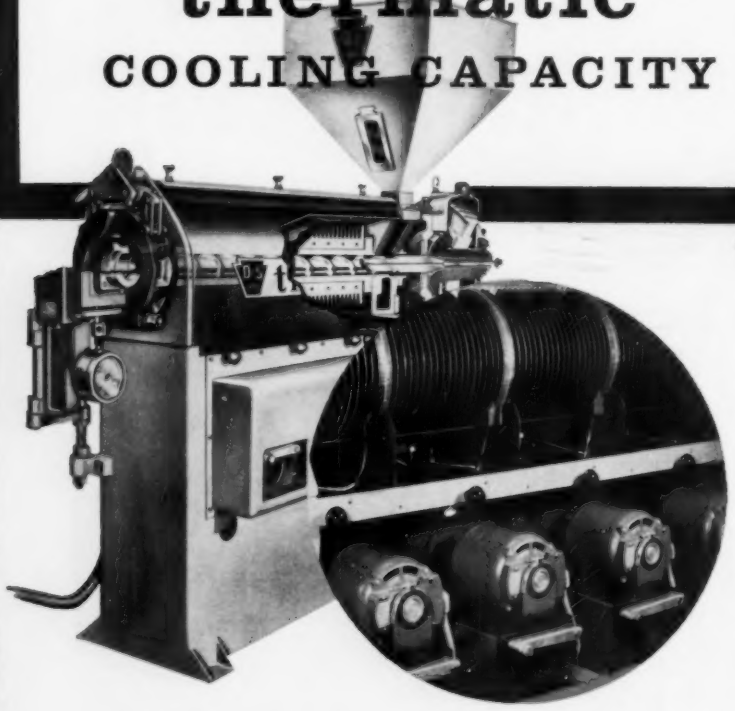

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Thermatic* Series extruders have enough cooling capacity to permit:

(A) High heat application at the feed section heat zone for fast melt and low horsepower consumption ... with

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(C) Higher head pressure with stable stock temperature provides thorough mixing and higher quality pipe.

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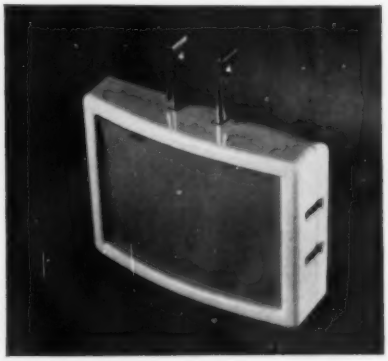
in microminiature capacitors as well as electroluminescence. At a frequency of 60 cycles, two-mil films have a dielectric constant of 10-15 and a dissipation factor of 0.010-0.025.

Films of Cyanocel can be cast on any flat, smooth surface. For electroluminescent applications, such as the General Electric Co. night light, glass or fiberglass supported film is important. The combination of Cyanocel with metal foil is advantageous in capacitor applications.

In electroluminescence, electrical energy is transformed directly into light. The Cyanocel acts as a carrier from phosphors, which glow when excited by electricity. The carrier is placed between two conducting plates, one of which is translucent. The electroluminescent lamp can be hung flat against the wall or at any angle.



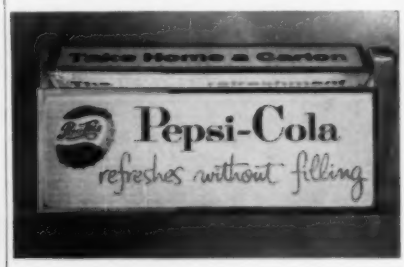
General Electric electroluminescent lamp.

Readers' Service Item 51

Back-lighted butyrate sign

A Pepsi-Cola sign vacuum formed from translucent Tenite butyrate rotates at point of purchase for increased sales. The triangular top section, with product slogans on three sides, rotates by means of a small motor. The stationary sign face is also decorated.

Tenite butyrate is supplied by Eastman Chemical Products, Inc. The sign is manufactured for Pepsi-Cola Co. by The Countryman Co., Inc., from sheet extruded by General Plastics Corp.



Rotating Pepsi-Cola sign.

Readers' Service Item 52

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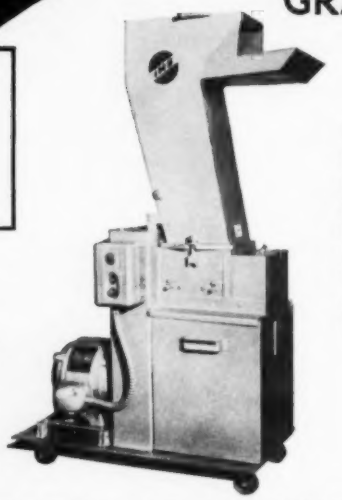
INJECTION MOLDERS!

BOOST PRODUCTION!

M-3 IMS M-4 GRANULATORS

All machines illustrated here in stock for

IMMEDIATE SHIPMENT



The IMS M-3 6½" x 7" throat sprue grinder — rugged — simple in design — easiest to clean — built-in throat clearance bar — casters — catch pan.

PRICE: Complete with 1 HP Motor and Starter ... $628.50
Same, but with 2 HP Motor $678.00

The IMS M-4 5⅜" x 8½" throat grinder — designed primarily for vinyl, polyethylene, plastisols and all elastomerics where a fine-free low bulk factor product is desired — large throat for large injection molded parts.

PRICE: Complete with 2 HP Motor and Starter $815.00
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LOW COST "MIDGET" TEMPERATURE REGULATOR

Duplicates performance of mold heaters costing up to 6 times as much... new more compact model with closed circuit ends mold rust... cuts your water bills! Temperature range 50° to 250°... Portable, only 15" x 22½" floor space.

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Send for our Nozzle and Plant Equipment Catalogs Today! You'll find all IMS stock injection plant accessories fully described and priced.

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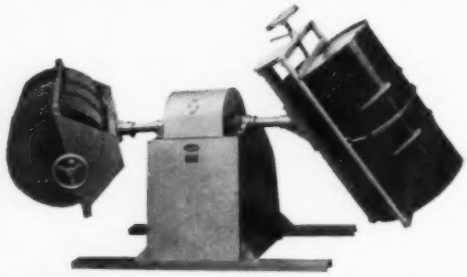

¾ HP Model $675.00
(Takes drums up to 33" high x 22" in diam.)
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(Takes drums up to 37" high x 23¼" in diam.)
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(Takes drums up to 43" high x 24" in diam.)
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New Literature

For more information check Readers' Service Card (p. 83)

"Quality Plastics for Quality Products." B. F. Goodrich Chemical Co. 18 pages. Descriptions of Geon vinyls, Abson ABS materials, and Estane polyurethanes. Illustrations of applications.

Readers' Service Item 61

"Cosomatic Object Imprinting Machines." Cosom Engineering Corp. 4 pages. Flat bed letterpress and flexographic printers and rotary flexographic printers are illustrated. Specifications and features.

Readers' Service Item 62

"Engineering Compara Chart." Mycalex Corp. of America. 4 pages. Comparisons of electrical, thermal, and physical properties of insulating materials. Tables of Fahrenheit temperature limits for 88 materials, and thermal expansion coefficients of 57 insert metals and insulating materials.

Readers' Service Item 63

"Bostik Clear Urethane Coatings." File 1-60. B. B. Chemical Co. 4 pages. A series of 12 clear urethane coatings, designed to serve where varnishes or lacquers had previously been used, is described. Properties and applications are contained.

Readers' Service Item 64

"Facts About Plastics." Cadillac Plastic & Chemical Co. 6 pages. This booklet compares outstanding properties and typical industrial applications of 13 major plastic families. Information is presented briefly.

Readers' Service Item 65

"Granular Solids Mixing." Reprint I-81. Sprout, Waldron & Co., Inc. 4 pages. This article describes design and performance criteria for vertical and horizontal mixers and blenders, including the pros and cons of the two types.

Readers' Service Item 66

"Solenoid Valves and Electromagnetic Control." Circular VS-51. Automatic Switch Co. 4 pages. This brief catalog of the company's line lists and illustrates 2, 3, and 4 way solenoid valves; emergency control systems; remote control switches and systems; and contactors, relays, and solenoids.

Readers' Service Item 67

"Carlon Plastic Conduit." Catalog EC-66. Carlon Products Corp. 24 pages. Products covered include underground conduit in light wall weight for concrete encasements and in heavy wall weight for direct burial, and two types of P.V.-Duit, a PVC conduit in two wall thicknesses suitable for extremely corrosive conditions above or below ground. Recommended for distributors, engineers, purchasing agents, and contractors.

Readers' Service Item 68

"Adamson Shaw Intermix." Adamson United Co. 6 pages. The brochure provides descriptions, illustrations, and diagrams of major design and construction features of this internal mixer. Tables give sizes, drives, and performance ratings with various types of drives.

Readers' Service Item 69

"Cycolac Product News." Volume 2, Number 2. Marbon Chemical, Division of Borg-Warner Corp. 4 pages. Automotive applications of ABS plastic are illustrated.

Readers' Service Item 70

"Roll Catalog." Bulletin No. 601. Barclay Machine, Inc. 4 pages. Describes and illustrates construction of rolls with stub shafts and through shafts; with fabricated bodies and cast bodies; alloy rolls and stainless steel rolls; plastic and rubber covered. Designed for use in strip handling and processing, with rubber, wire mesh, or fabric belts.

Readers' Service Item 71

"Product Bulletin." Stowe-Woodward, Inc. 12 pages. Charts list maximum concentrations and highest temperatures at which specific materials can be used with different thermoplastic and thermosetting materials.

Readers' Service Item 72

"Celogen Blowing Agents." Naugatuck Chemical Division, U.S. Rubber Co. 6 pages. Celogen-AZ blow agent can be used for expanding polyethylene, polypropylene, ABS, PVC, and other polymeric materials. Uses with different forms of polymers are explained, with advantages.

Readers' Service Item 73

"A Guide to the Use of Tenite Butyrate for Colorful, Durable Outdoor Signs." Eastman Chemical Products, Inc. 46 pages. A comprehensive, attractive guide to planning, designing, forming, fabricating, decorating, and illuminating signs of Tenite butyrate, a material noted for ease of forming, weatherability, and light transmission and diffusion properties. Profusely illustrated. Lists sources for butyrate sheet and letters, lacquers, and vacuum forming machines.

Readers' Service Item 74

"Uniform Replacement Heaters for 12-16 Ounce Impco Machines." Stock Heating Cylinders for Reed Prentice 10A4 Machines." Injection Molders Supply Co. 2 pages. Dimension diagrams, illustrations, features.

Readers' Service Item 75

"Comet Meteor Automatic." Comet Industries. 4 pages. Features, specifications, and illustrations of a machine for general vacuum forming and skin packaging.

Readers' Service Item 76

"Recommendations for Proper Extrusion of Cycolac ABS Plastics." Extrusion Bulletin No. 3. Marbon Chemical Division, Borg-Warner Corp. 1 page. A list of problems which may be encountered in extrusion, with several possible solutions. Covers variations in dimensions, pulsations, lumps, rough surfaces or porosity, and poor sheet appearance.

Readers' Service Item 77

"Perma-Mold Release Agents for Polyurethane Foams." Bulletin No. 1160. Brulin & Co., Inc. 3 pages. The company supplies six formulations for use as mold release agents with molded polyurethane foams. Details about the properties, components, application, and selection of mold release agents are supplied in this brochure.

Readers' Service Item 78

"Hi-Viz Fluorescent Pigments." Lawter Chemicals, Inc. 8 pages plus set of 9 color chips. Printed literature includes technical bulletins, formulations, etc. of these fluorescent pigments for use in plastics. The styrene color chips are graduated in thickness to show the differences in fluorescent translucency.

Readers' Service Item 79

"Resin Guide 1960-1961." Naugatuck Chemical Division, U. S. Rubber Co. Property data, special features, and recommended uses of Vibrin polyester resins, Kralastic ABS compounds, and Marvinol PVC resins are tabulated. Brief information on other products for plastics is provided.

Readers' Service Item 80

AMOCO ISOPHTHALIC Acid-95

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available now in commercial quantities

Polyester resin manufacturers—here's your needed new source for Isophthalic Acid. Check these quick facts.

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- Using AMOCO Isophthalic Acid-95 you get the superior qualities normally associated with an IPA based resin—(1) A better combination of rigidity and impact strength, (2) Better strength retention after environmental aging, (3) Better resistance to chemicals and acids.
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You get these

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- AMOCO Isophthalic Acid-95 contains uniquely low concentrations of heavy metals and of total metals.
- With AMOCO Isophthalic Acid-95 there is less oxygen sensitivity during processing thus reducing the number of precautions necessary when making Isophthalic resins.
- Uniform polyester quality from batch to batch.
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- Permits manufacture of resins with better shelf stability at lower inhibitor levels.
- Permits the manufacture of lighter colored resins.

You get these

Packaging and Shipping Benefits

- A Midwest manufacturing source—Joliet, Ill.
- Availability in commercial quantities from the Joliet plant and from warehouses in New York, Cleveland and Detroit.
- Available in 80 lb. bags in conventional or unitized shipments.

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Book Reviews

"An Introduction to the Organic Chemistry of High Polymers." Carl S. Marvel. John Wiley & Sons, Inc., 440 Park Ave., New York 16, N. Y. Cloth 9-½ by 6-¼ inches, 82 pages. $4.50.

This very aptly titled monograph is derived from the June 1956 Humble Lectures in Science. Intended for the student beginning study of high polymers, it presumes acquaintiance with the nomenclature of organic chemistry.

Beginning with a brief historical background of polymer chemistry, the author defines essential terms and discusses methods used to characterize polymers. The remainder of the volume is devoted to a study of polymer formation and reactions. The information is presented as a survey, with much reference to patent literature. It is divided into sections on condensation polymerization, addition polymerization by free radical initiation and by ionic initiation, copolymerization, diene polymerization, and reactions of polymers.

From this book, one can learn not only what has been done in these different areas of polymer chemistry, but about current projects as well. Those interested in an overview of the science, without wishing to pursue extended study, will find it serves their purposes, as will those for whom it is merely the first textbook.

"Metallizing of Plastics." Harold Narcus. Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. Cloth 7¾ by 3½ inches, 208 pages. $5.50.

Dr. Narcus, developer of the Narcus Process for deposition of copper films on plastics, has written a well-organized, comprehensive survey of methods and techniques for metallizing plastics. Almost anyone interested in metallizing will find the book of value, for even though it is written in easy-to-understand language, it contains the detailed information of interest to the specialist. Thus it is a reference both for the generally as well as specifically concerned audience.

After a brief introduction dealing mainly with purposes and applications of plastics metallizing, the author plunges into discussion of individual metallizing processes. The five main methods—deposition of metallic coatings by chemical reduction, vacuum metallizing, cathode-sputtering, silver-spray, and electrodeposition—are discussed in individual chapters. These methods are considered important not only because of decorative, but industrial use, as well. A sixth chapter is concerned with miscellaneous metallizing methods, including conductive paints, metal spraying in mold production, gas plating, and preparation of conductive plastics. The book concludes with sections on the characteristics and testing of metallized films and on the future potentials of metallizing and metallized products.

The author discusses each of the five main processes in considerable detail. While theory is explained, the emphasis is on practical application. Therefore, step-by-step information on equipment set-up, preparation of molded items, deposition of the film, finishing and/or lacquering, and clean up is provided. Vacuum metallizing, which has shown enormus growth in recent years, justifiably receives the largest amount of space.

A summary of the exposition of vacuum metallizing (metal evaporation) will indicate the tone and approach of the author. The chapter begins with discussion of general characteristics, such as basic procedure, advantages and disadvantages, and success with plastics. The four essential parts of vacuum metallizing equipment—a holder for parts, a heater for metal, a vacuum chamber, and a pump—are analyzed in detail. The discussion also includes accessory items. The succeeding section on operation enumerates methods, purposes, choice of materials, precautions, and finishing. Thus, within this chapter, the reader can find a practical guide to vacuum metallizing, including references for those topics he wishes to explore in greater depth.

Both end user and processor will find this book a readable reference on metallizing. It also can serve as a reference in choosing the most practical and economical method of metallizing specific plastic moldings.

"Phenolic Resins." David F. Gould. Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. Cloth, 7-¾ by 5-¼ inches, 213 pages. $5.75.

Phenolic resins, which first appeared commercially in 1909, are second in age only to the cellulosics. It is perhaps for this reason that even though production mounts steadily, they do not seem to receive as much publicity as the newer plastics. Yet, according to Mr. Gould, "if we had had no phenolic resins heretofore, the introduction of resins with the properties of the best phenolics of today in all probability would be sensational."

Most phenolic resins are the condensation products of phenols, which are substances characterized by the presence of hydroxyls groups attached to benzene rings, with formaldehyde. There are, however, many phenols, and many substances other than formaldehyde with which they will react. A wide variety of resins with different properties can be manufactured by varying the type and proportion of the reactants.

Most phenolics are thermosetting, as are the four main types used in molding: granular powders, radom-laid fibers coated with resin, chopped fabric saturated with resin, and resin and fillers plasticized with solvents. Methods of formulating, blending, molding, and curing theset types are presented. Succeeding chapters cover the uses of phenolics in such items as adhesives, laminates, bonding and impregnating agents, and protective coatings.

This survey seems to be introductory. Those who already are at work with phenolics will probably find it too elementary. It is interesting to observe, however, the applications of a plastic which has been available for several decades, one which has found hundreds of applications for which it is suited. Since the color, cure time, and heat resistance qualities of phenolics are being improved, they will undoubtedly also find uses for which it was previously unqualified.

"Linear and Stereoregular Addition Polymers: Polymerization with Controlled Propagation." Norman G. Gaylord and Herman F. Mark. Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y. Cloth, 6½ by 9 inches, 571 pages. $17.50.

Volume II of Interscience's series, Polymer Reviews, attempts to organize, summarize, and interpret the mass of journal and patent literature that has followed the discoveries of Ziegler and Natta.

The following topics are covered by the text: homogenous addition polymerization kinetics, adsorption on surfaces and complex formation, requirements for stereospecific polymerization, structure of olefin polymers in the solid state, solution properties of linear polyethylenes and isotactic polymers, fluid-bed polymerization processes with Ziegler-type catalysts and others, fixed-bed polymerization processes, polymerization of olefin oxides, physical properties of olefin oxides, and miscellaneous organometallic-catalyzed polymerization systems.

Chapter XII is a monumental tabulation of international patents occupying 132 pages. The patents are organized by subjects. Polymerization of different monomers with Ziegler-type catalysts, lithium-based catalysts, supported chromium oxide catalysts, and other supported metal oxide catalysts is included. Weight of catalysts, conditions of polymerization, yield, and properties of polymer are tabulated, as well as patent reference.

Since information on the subject of this monograph has been published in abundance, appendices to many chapters have been included for developments which occurred after the book was in proofs. It is a very respectable, comprehensive piece of research, and can be read by any interested in the chemistry, preparation, or processing of polyolefin materials.

Article Abstracts

Materials

"Silicon-Containing Polymers," H. Gibello, MATIERES PLASTIQUES, 7, 71, 499; 7, 72, 565; 7, 73, 665; 7, 74, 716 (July, Aug., Sept. & Oct. 1960).

The first installment includes general remarks on the composition of organosilicon compounds, silicones and their applications, followed by a study of recent research in these fields. The other three parts are devoted to brief abstracts of patents granted in France after January 1, 1950. (In French.)

"Water Absorption of Unplasticized PVC," H. Uijlenburg, IND. PLASTIQUES MOD., 12, 7, 41 (Aug.-Sept. 1960).

Prolonged exposure of pipe made of different types of PVC to temperatures of 50° C. and over increase tensile, but reduce impact strength. No correlation is found between changes in these properties and water absorption. A testing temperature of about 40° C. is suggested since secondary phenomena seem to be produced at 60° C. (In French.)

"The Materials for Wire and Cable Insulation Manufacturers Wish for," J. Bele, IND. PLASTIQUES MOD., 12, 7, 37 (Aug.-Sept. 1960).

Some of the problems created by the increasing performance demands on materials for insulating wires and cables are discussed. The author notes the present inadequacies and indicates desired progress in quality of basic material, processing and testing, and concludes with the wish for active collaboration between research centers, plastics producers, cable manufacturers and consumers. (In French.)

"Rigid Polyurethane Foams," R. G. Tainturier, IND. PLASTIQUES MOD., 12, 7, 61 (Aug.-Sept. 1960).

A discussion of the chemical constitution of polyurethanes, the principles of foam production, and toxicity problems, is followed by a description of the manufacture of foams, the properties of the four different types of rigid foams, and applications. (In French.)

"French Production of Fiberglass Surface Mats," J. M. Borias, IND. PLASTIQUES MOD., 12, 7, 68 (Aug.-Sept. 1960).

Review of French and foreign production and application of fiberglass surface mats. (In French.)

"The Use of Glass-reinforced Plastics in the Chemical Industry and in Chemical Engineering," G. De Luca, POLIPLASTI, 8, 40 (May-June 1960).

In Italy, the use of glass-reinforced plastics has not yet reached the level of some other countries, particularly the United States. The author discusses the properties of these materials and describes British and American methods of using them in the production of pipe, tanks, trays, valves, cisterns, for the chemical industry. (In Italian.)

"Polyethylene Glycol Terephthalate. Parts I and II," E. Ferraris, MATERIE PLASTICHE, 24, 7, 689; 24, 8, 775 (July & Aug. 1960).

In Part I, this review of polyethylene glycol terephthalate covers the history, and synthesis of the polymer, and the production and applications of the fiber. Part II deals with the film, tables giving physical, optical, chemical and other properties. Metallization, sealing, and bonding of the film are described. Trade names and manufacturers of fibers in various countries are listed and similar data, as well as descriptive details, are tabulated for film and film adhesives. There are 142 references, including numerous international patents. (In Italian.)

"New Transparent, Thermoplastic Copolymers from Derivatives of an Acid Obtained by Fermentation," E. Condorelli and L. Spano, POLIPLASTI, 8, 40, 3 (May-June 1960).

At the 11th Plastics Congress held in Turin last year, two new types of transparent thermoplastic copolymers were briefly described: a binary copolymer of styrene and dimethyl itaconate, and a ternary copolymer of styrene, dimethyl itaconate, and acrylonitrile. Full details are now given of studies to determine reactivity constants of the monomers and the kinetics of polymerization which led to the production of the ternary copolymer. The exceptional properties of the latter are indicated. (In Italian.)

In the reference system used, the first number following the magazine name is the volume number, the second is the issue number (if any), and the third is the first page on which the abstracted article appears in that magazine.

Requests for copies, reprints, or further information on any article abstracted in this department should be addressed to the publisher of the magazine where the article appeared. A complete listing of the publishers and addresses of these magazines is printed here quarterly.

The next complete listing will appear in May. The last listing appeared in the January issue.

"Vinyl Compounds for Extrusion," A. Mathé, IND. PLASTIQUES MOD., 12, 7, 25 (Aug.-Sept. 1960).

The author discusses the methods by which the most suitable products for a specific extruded article can be selected from a wide range of materials. He considers plasticizers, stabilizers, fillers, and pigments, and describes tests on the extrusions, referring especially to the Clash and Berg curves. (In French).

"Semi-Manufacturers of Thermoplastics/Fiber Glass Laminates," W. Stiner, PLASTVERARBEITER, 11, 7, 320 (July 1960).

A new Swiss laminate consisting of a thermoplastic (preferably a low-pressure polyethylene or polypropylene) combined with a layer of fiber glass or asbestos fibers on one side, is claimed to be especially suitable for chemical apparatus. Tests are described showing its unusually high flame resistance. (In German.)

"Fabric-Reinforced PVC Film has Greater Tear Strength," R. Schmitt, PLASTVERARBEITER, 11, 7, 326 (July 1960).

Tear strength of flexible PVC and polyethylene film can be substantially increased by reinforcement with a wide-meshed web of cotton or glass silk. Tear tests and welding conditions are discussed. (In German.)

"Reinforced Resin Evaluation for Wet Strength Retention," C. E. Loetel and H. E. Fordyce, SPE J., 16, 10, 1137 (Oct. 1960).

It is shown that, in general, the isophthalic-based polyester resins give a decided increase in wet strength retention over the average phthalic anhydride resins.

"Methyl Acrylate as a Monomer in Glass Fiber Reinforced Polyester Laminates," M. C. Slone, SPE J., 16, 10, 1123 (Oct. 1960).

Data are given to show that methyl methacrylate-modified resins show superior resistance to weathering and superior light stability than standard polyester resins made with styrene cross-linking.

"The Effect of Orientation on the Physical Properties of Injection Moldings," G. B. Jackson and R. L. Ballman, SPE J., 16, 10, 1147 (Oct. 1960).

A method is given for determining birefrigence of molding resins which can be used for control of molding and rapid, non-destructive estimate of properties at different points of the molding.

Equipment

"A New Device for Determining Shear Properties of Reinforced Plastics," A. P. Penton, SPE J., 16, 11, 1246 (Nov. 1960).

Details are given for a picture-frame loading device that make design data on shear loading easily obtainable.

"Optical Gaging—A Valuable Tool," J. D. Portello, MODERN PLASTICS, 38, 3, 124 (Nov. 1960).

The optical comparator is shown to save time and money in inspection of precision molded parts.

"Device for Measuring Stress Relaxation of Plastics," R. J. Curran, R. D. Andrews, Jr., and F. J. McGarry, MODERN PLASTICS, 38, 3, 142 (Nov. 1960).

Description of a relaxation device for specimens held between grips for testing.

"Breakthrough in Mold-Making—Electro-Erosion," Frank Jaques and Joseph Schmidt, MODERN PLASTICS, 38, 4, 109 (Dec. 1960).

Description of a new electrical-discharge machine for cutting high-quality mold cavities in hardened steel.

The Use of Electron Tearing Instruments for Use with Plastics Sheeting," H. Grimminger, KUNSTSTOFFE, 50, 11, 18.

Description of a new instrument which produces force/deformation curves even in plastics films which are multi-axially pressed by impact and tension.

"New Cells for Dielectric Measurements," F. Oehme, KUNSTSTOFFE, 50, 11, 627 (Nov. 1960).

The author describes new developments in dielectric cells, particularly a cell for examining sheet stock 1-10 mm. thick. Marginal errors are avoided by standardizing with materials of known dielectric constants.

"Multi-Impression Injection Molding Tool with Centrally-Punched Gate," H. Gastrow, KUNSTSTOFFE, 50, 11, 647 (Nov. 1960).

Description of a tool for use in injection molding.

Applications

"Considerations on the Construction of a Re-oxidation Tower of Rigid PVC." F. De Simone, MATERIE PLASTICHE, 24, 7, 668 (July 1960).

After considering the factors important for the construction of tall structures, the author describes a two-part reoxidation tower consisting of a removable, self-supporting cylinder 10-feet in diameter and 33-feet high, made of 5-mm. thick PVC, and mounted on a steel framework, the entire structure also being surrounded by a steel framework. (In Italian.)

"Styropor Foam in Structural Elements," F. Stastny, KUNSTSTOFF-RUNDSCHAU, 7, 7, 317 (July 1960).

The author describes the application of panels of styropor foam in buildings (for heat, cold and sound insulation), sandwiched with concrete for walls or as backing for ceramic and other tiling, as well as in combination with glass-reinforced polyester resins. Properties of some of the combinations are tabulated. (In German.)

"Applications for Cold-setting Plastics Foams," H. Baumann, KUNSTSTOFF-RUNDSCHAU, 7, 7, 323 (July 1960).

Isoschaum, a cold-setting, urea-formaldehyde foam, formed in situ, has been accepted by the authorities as suitable for insulating gaspipe conduits to prevent spreading of explosions. Tests on fibration resistance and form stability are described, and an example is given of the encasing of non-supported pipe with Isoschaum and expanded metal. (In German.)

"Emulsion Polymers for Paints," R. T. Goodchild and R. B. Evans, APPLIED PLASTICS, 3, 4, 41 (April 1960).

A review of theoretical aspects and practical considerations.

"Laminated Polyester-Glass Screw Blades," L. Vadat, IND. PLASTIQUES MOD., 12, 5, 37 (June 1960).

Designs employing fiberglass cloth or rovings, sometimes combined with foamed polystyrene or other foamed plastics, have been produced experimentally and commercially for screws 2-35 meters in diameter in high speed air generators. (In French).

"Plastics in Building—A Survey," G. Schulz, KUNSTSTOFFE, 50, 6, 357 (June 1960).

The author stresses the importance of adapting applications to the characteristics of the materials, and of catching up on the knowledge required to process the semi-finished materials correctly.

"A Plastics Bungalow," R. Frenz, KUNSTSTOFFE, 50, 6, 360 (June 1960).

A house made exclusively of plastics is still an ideal, but it seemed advisable to try out a model example in that field. The architect for the bungalow discusses the project.

"Prospects for the Use of Plastics in Automobiles," Chateau, Lagache, and Morisseau, IND. PLASTIQUES MOD., 12, 7, 28 (Aug.-Sept. 1960).

In view of the growing use of plastics elements in automobiles, it has become highly desirable that plastics manufacturers give exact information regarding the mechanical and processing qualities of materials, especially of thermoplastics, that automobile designers may wish to use. How these qualities, design, and service conditions are related is discussed. (In French.)

"Plastics and Photography," H. P. Zade, PLASTICS (LONDON), 25, 273, 263 (July 1960).

A brief discussion of photographic usages.

"Prefabricated Plastics Cottage," A. Belliamo and A. Zorzoli, MATERIE PLASTICHE, 24, 7, 663 (July 1960).

The circular structure described is 25 feet in diameter and can be assembled in 20 working hours from panels of glass-reinforced polyester resin and rigid polystyrene foam sandwich material. It has good thermal and acoustic insulation, as well as strength. (In Italian.)

"Survey of Plastics in Ordnance," H. E. Pebly, Jr., WESTERN PLASTICS, 7, 7, 33 (July 1960).

A brief survey of ordnance uses for plastics.

"ABS Plastics are Low Cost, Tough, Resistant, Moldable," M. W. Riley, MATERIALS DESIGN ENG., 52, 1, 108 (July 1960).

A review of the ABS plastics.

"The MAS Glass Fiber/Resin Spraying Process for the Production of Glass Fiber-Reinforced Moldings and for Coatings Based on Unsaturated Polyester Resins," E. Escales, KUNSTSTOFFE, 50, 4, 224 (April 1960).

A spraying machine for simultaneous deposition of glass fiber and resin.

"Plastic Tooling for Plastics Production," F. L. Bogart, PLASTICS WORLD, 18, 6, 18 (June 1960).

A brief review of some late techniques and developments.

"Plastics as Thermal Protection of Hypersonic Vehicles," WESTERN PLASTICS, 7, 4, 19 (April 1960).

Material and design considerations make the plastics suitable for this usage.

General

"Plastics in the West," J. D. Gaut, CANAD. PLASTICS, pg. 34 (Dec. 1960).

A short note on plastics achievements in Western Canada.

Patent Digest

Materials

Coated Vinyl Chloride Plastisol Resin Particles Coated with a Carboxylic Acid Salt and Method of Preparation. No. 2,948,638. B. O. Baird, Bay Village, O., and R. P. Davie, St. Albans, W. Va. (to B. F Goodrich Co., New York, N. Y.)

High Molecular Weight Polyether Urethane Polymers. No. 2,948,691. E. Windemuth, H. Schnell, and O. Bayer, Leverkusen, Germany (to Mobay Chemical Co., St. Louis, Mo., and Farbenfabriken Bayer AG., Leverkusen Bayerwerk, Germany).

Polyvinyl Chloride Composition Containing Hydrocarbon Tar. No. 2, 948,695. F. P. Ford, Roselle, N. J., G. E. Jasper, Bronxville, N. Y., and J. F. Nelson, Westfield, and L. M. Welch, Madison, N. J. (to Esso Research and Engineering Co.).

Plasticized Polyvinyl Alcohol Composition. No. 2,948,697. J. A. Robertson, Lewiston, N. Y. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

Polyamide Molding Compositions. No. 2,948,698. A. J. Cocci, Leominster, Mass. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

Isocyanate-Based Polymers Containing at Least Two Different Types of Polymeric Segments. No. 2,948,707. A. F. Benning, Woodstown, N. J. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

Copolymers of Styrene and Fluorinated Dienes. No. 2,949,446. F. J. Honn, Westfield, N. J. (to Minnesota Mining & Mfg. Co., St. Paul, Minn.).

Cross-Linked Polycarbonate Resinous Compositions and Method for Preparing Same. No. 2,950,266. K. B. Goldblum, Pittsfield, Mass. (to General Electric Co.).

Poly-α-Olefin Compositions Containing 4-Alkoxy-2-Hydroxybenzo-Phenones and N, N'-Diphenyl-p-Phenylenediamine. No. 2,947,721. G. C. Newland and J. W. Tamblyn, Kingsport, Tenn. (to Eastman Kodak Co., Rochester, N. Y.).

Elastic Polyurethane Composition and Method for Making Same. No. 2,951,053. F. G. Reuter and J. Ulderup, Lemforde, Hannover, Germany (to Mobay Chemical Co., Pittsburgh, Pa.).

Linear Polyethylene Stabilized with Organic Esters. No. 2,951,056. C. R. Pfeifer and R. L. Hudson, Midland, Mich. (to Dow Chemical Co., Midland, Mich.).

Stabilization of Acrylonitrile Copolymers. No. 2,951,055. L. B. Luttinger, Stamford, Conn. (to American Cyanamid Co., New York, N. Y.).

Stabilized Polymeric Oxetane Molding Compositions. No. 2,947,722. H. Boardman, Wilmington, Del. (to Hercules Powder Co., Wilmington, Del.).

Chloroethylene Polymers Stabilized with 2,4-Dihydroxy-3-Allyl Benzophenone and Substituted Derivatives Thereof. No. 2,947,723. G. A. Clark, Midland, Mich. (to Dow Chemical Co., Midland, Mich.).

Copolymer of 2,2,2-Trifluoroethyl Acrylate and Vinylidene Chloride. No. 2,947,-734. B. D. Halpern, Jenkintown, and W. Karo, Elkins Park, Pa. (to Borden Co., New York, N. Y.).

Polyolefins. No. 2,945,792. A. A. Miller, Schenectady, N. Y. (to General Electric Co.).

Polyvinyl Chloride Plastisol Containing an alkylbiphenyl and Alkyl Ester of a Dicarboxylic Acid. No. 2,945,832. J. Dazzi, Dayton, O. (to Monsanto Chemical Co., St. Louis, Mo.).

Novel Perfluorocarbon Polymers. No. 2,946,763. M. I. Bro and B. W. Sandt, Wilmington, Del. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

Heat Stabilized Vinyl Chloride Resin Plastisols. No. 2,946,764. A. D. Fon Toy, Park Forest, K. H. Rattenbury, S. Chicago Heights, and T. M. Hinkes, Park Forest, Ill. (to Victor Chemical Works).

Printed copies of patents are available from the Commissioner of Patents, Washington 25, D. C. Prices, 25c each.
—The Editor

Linear Polymers Containing Regularly Recurring Ester and Amide Linkages. No. 2,946,769. J. K. Rose, S. Charleston, and H. W. Schulz, Charleston, W. Va. (to Union Carbide Corp.).

Aliphatic Ester Group and Hydroxyl Group Containing Interpolymers. No. 2,945,835. E. C. Chapin, Springfield, Mass., and R. F. Smith, Delmar, N. Y. (to Monsanto Chemical Co., St. Louis, Mo.).

Stabilized Polymethacrolein Compositions with Phenols or Mercaptobenzimidazoles. No. 2,945,837. R. L. Eifert and B. M. Marks, Wilmington, Del. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

Resins from Epoxidized Liquid Polybutadiene and Neutral Esters of Polybasic Acids. No. 2,946,756. C. E. Wheelock and J. E. Wicklatz, Bartlesville, Okla. (to Phillips Petroleum Co.).

Composition of Polyethylene and a Copolymer of Ethylene and Ethyl Acrylate. No. 2,953,541. R. J. Pecha, New Brunswick, H. Samuels, Somerville, and D. C. Kay, Franklin Township, Somerset County, N. J. (to Union Carbide Corp.).

Stabilized Polymer Compositions. No. 2,953,542. E. Start, Gendorf, Upper Bavaria, and M. Albrecht and G. Keicher, Gersthofen, near Augsburg, Germany (to Farbewerke Hoechst AG, vormals Meister Lucius & Bruning, Frankfurt am Main, Germany).

Polyamides from Branched Chain Diacids. No. 2,953,548. S. Schott and H. Greenberg, Cincinnati, O. (to National Distillers and Chemical Corp., New York, N. Y.).

Copolymers of Vinyl Chloride and Alkenyl Esters of 3,4-Epoxycyclohexane--1,1-Dimethanol. No. 2,953,550. F. C. Froxtick, Jr., and B. Phillips, Charleston, W. Va. (to Union Carbide Corp.).

Aqueous Dispersion Containing Acrylic Acid Copolymer and Aliphatic Polyepoxide. No. 2,954,358. M. D. Hurwitz, Huntingdon Valley, Pa. (to Rohm & Haas Co., Philadelphia, Pa.).

Patent Digest (Cont'd.)

Silicone Compounds and Elastomers Prepared Therefrom. No. 2,954,357. F. Fekete, Tonawanda, N. Y. (to Union Carbide Corp.).

Viscosity Stabilized Melt Extrudable Perfluorocarbon Polymers. No. 2,955,099. R. S. Mallouk and B. W. Sandt, Wilmington, Del. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

Antiseptic Plastic. No. 2,951,766. L. A. White, Hazardville, Conn.

Polymer of Trifluorochlorethylene and Preparation Thereof. No. 2,951,783. B. F. Landrum, Cedar Grove, N. J., and R. L. Herbst, Jr., Worcester, Mass. (to Minnesota Mining & Mfg. Co., St. Paul, Minn.).

Ion Exchanger Membranes from Polyvinylidene Chloride and Phenolic Resin Reactants. No. 2,951,818. K. Haagen, Leverkusen-Bayerwerk, Germany (to Farbenfabriken Bayer AG, Leverkusen, Germany).

Pigmented Polyethylene Extrusion Composition. No. 2,951,821. W. L. Kesling, Livonia, Mich. (to Union Carbide Corp.).

Unsaturated Polyesters of Unsaturated α,β-Dicarboxylic Acids and Polyvalent Alcohols. No. 2,951,823. H. Sauer, Letmathe, Westphalia, Germany (to Rugerswerke-AG, Frankfurt, Germany).

Halogenated Epoxy Resins. No. 2,951,829. M. E. Chiddix and R. W. Wynn, Easton, Pa. (to General Aniline & Film Corp., New York, N. Y.).

Fungus-Resistant Elastomer. No. 2,951,830. B. D. Halpern, Jenkintown, and W. Karo, Elkins Park, Pa. (to Borden Co., New York, N. Y.).

Terpolymer of a Conjugated Diolefin, a Styrene, and an Allyl Alcohol. No. 2,951,831. R. H. Reinhard, Galveston, and J. E. Fox, Texas City, Tex. (to Monsanto Chemical Co., St. Louis, Mo.).

Method of Stabilizing Vinyl Aromatic Polymer Foams. No. 2,952,593. L. C. Rubens, Midland, Mich. (to Dow Chemical Co., Midland, Mich.).

Polyethylene Compositions of Improved Clarity Comprising Polyethylene and a Polyurethane and Process of Making Same. No. 2,955,098. A. G. M. Last, Welwyn Garden City, England (to Imperial Chemical Industries Ltd., London, England).

Stabilized Masses of Polyvinyl Compounds Containing Halogen. No. 2,954,363. W. Kuehne, Mannheim, H. Pohlemann, Ludwigshafen (Rhine), and H. Krzikalla, Heidelberg, Germany (to Deutsche Advance Produktion G.m.b.H., Koln (Rhine), Germany).

Composition Comprising Trifluorochloroethylene Copolymer and Silica and Process for Molding Same. No. 2,954,359. L. E. Robb, Westfield, and D. R. Wolf, Bloomfield, N. J. (to Minnesota Mining & Mfg. Co., St. Paul, Minn.).

Equipment

Extrusion of Solid Rocket Grains. No. 2,952,876. G. E. Miles, Waco, Tex. (to Phillips Petroleum Co.).

Apparatus for the Drawing of Plastics. No. 2,952,875. W. D. Herrick, Wichita, Kans. (to Coleman Co., Inc., Wichita, Kans.).

Air Ring for Use in the Manufacture of Thermoplastic Tubing. No. 2,952,874. R. Doyle, Bartlesville, Okla. (to Phillips Petroleum Co.).

Apparatus for Extrusion of Plastic Pipe. No. 2,952,873. F. Porter, Morristown, N. J. (to Allied Chemical Corp.).

Production of Film. No. 2,952,872. R. H. B. Buteux and J. R. Cann, Welwyn Garden City, and J. W. Cornforth, Harpenden, England (to Imperial Chemical Industries, Ltd., London, England).

Blow Molding Machine and Process. No. 2,952,034. C. P. Fortner, Bloomfield, Conn. (to Plax Corp., Bloomfield, Conn.).

Apparatus for Forming Hollow Plastic Articles from Fluid Base Materials. No. 2,951,261. O. B. Sherman, W. Orange, N. J. (to Owens-Illinois Glass Co.).

Molding Mechanism and Heating Arrangement. No. 2,951,260. J. M. Harrison and R. E. Smucker, Fort Worth, Tex. (to Crown Machine and Tool Co., Fort Worth, Tex.).

Method and Apparatus for Injection Molding. No. 2,954,586. G. W. Wacker, 4762 Reading Rd., Cincinnati 37, O.).

Apparatus for the Production of Dental Plates and the Like from Plastic Material. No. 2,948,018. M. Hintermann, Emmendingen, and P. Ostermann, Kehl (Rhine), Germany (to Hingermann).

Crown Cap Lining Machine. No. 2,954,585. J. Simpson, Elmhurst, Ill. (to Continental Can Co., Inc., New York, N. Y.).

Molding Presses. No. 2,954,584. W. R. Groves, Wolverhampton, England (to British Industrial Plastics Ltd., London, England).

Presses. No. 2,954,583. H. R. Gregory, Piffs Elm, Chelthenham and M. Kendal, Cheltenham, England (to Coal Industry (Patents) Ltd., London, England).

Apparatus for Manufacturing Hollow Articles. No. 2,954,581. R. Colombo, Turin, Italy (to S. A. S. Lavorazione Materie Plastiche (L.M.P.) di M. I. Colombo & C., Turin, Italy).

Machine for the Manufacture of Tubular Containers. No. 2,953,815. T. Mainardi, Milan, Italy.

Method for Casting Buttons and the Like. No. 2,948,019. R. O. A. Petersen, Chatham, N. J. (to J. L. Burns, Greenwich, Conn.).

Aligned Double Cylinders and Rams for Plastic Mixing Apparatus. No. 2,948,920. J. M. Hausman, 3581 Edgewood Drive, Stow, O.

Screw Conveyor. No. 2,948,922. W. Meskat and J. Pawlowski, Dormagen, Germany (to Farbenfabriken Bayer AG.).

Machine and Method for Molding Heat-Curable Articles. No. 2,948,925. A. A. Johnson, Bridgeport, Conn. (to Eagle-Picher Co., Cincinnati, O.).

Apparatus for Producing Plastic Material. No. 2,945,258. J. C. Houston, Beaver Falls, Pa. (to Koppers Co., Inc.).

Method and Apparatus for Injection Molding. No. 2,950,501. R. J. Harkenrider, Winona, Minn. (to Continental Can Co., Inc.).

Die Assembly. No. 2,946,090. I. S. Houvener, Midland, Mich. (to Dow Chemical Co., Midland, Mich.).

(*Continued on page 79*)

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CALENDAR of COMING EVENTS

February 20-23
Technical Association of the Pulp and Paper Industry. Annual Meeting. Hotel Commodore, New York, N. Y.

February 26-March 1
American Institute of Chemical Engineers. Petrochemical and Refining Exposition. Municipal Auditorium, New Orleans, La.

March 1
Plastics Institute and Institution of the Rubber Industry. Joint Conference. Rubber and Plastics in Cables. Institution of Electrical Engineers, Savoy Place, London W C 2, England.

March 1-2
Society of Vacuum Coaters. Annual Technical Conference. Conrad Hilton Hotel, Chicago, Ill.

March 14
SPE Southern California Section RETEC. Plastics Finishing Seminar. Roger Young Auditorium, Los Angeles, Calif.

March 15-16
American Society of Tool and Manufacturing Engineers and SPE. Seminar on Plastics for Tooling. Hotel Statler, Detroit, Mich.

March 21-30
American Chemical Society. 138th National Meeting. St. Louis, Mo.

April 4-5
SPE Pioneer Valley Section RETEC. Plastics Injection Molding Workshop. Holy Cross College, Worcester, Mass.

April 20
SPE Western New England Section RETEC. Plastics—A New Dimension in Buildings. Springfield Museum of Art, Springfield, Mass.

April 20-21
SPI Eighteenth Annual Western Section Conference. Hotel del Coronado, Coronado, Calif.

May 9
SPE Detroit Section RETEC. Plastics in the Automotive Industry. Detroit, Mich.

May 22
ASME Design Engineering Conference and Show. Cobo Hall, Detroit, Mich.

June 5-9
SPI National Plastics Conference. Commodore Hotel, New York, N. Y.

June 5-9
SPI Ninth National Plastics Exposition. Coliseum, New York, N. Y.

June 11-15
ASME Summer Annual Meeting. Statler Hilton, Detroit, Mich.

June 14
SPE Quebec Section RETEC. Plastics in Packaging. Montreal, Quebec, Canada.

June 16-25
Europlastic 61. International Plastics Exhibition. Palais des Floralies, Ghent, Belgium.

June 19-20
Plastics Institute. Education and Training in the Plastics Industry. Institution of Electrical Engineers, Savoy Place, London W C 2, England.

(Continued from page 78)

Mold for and a Method of Producing Large Bodies of Foamed Polystyrene. No. 2,948,926. R. Kuhn, Grunstadt, Pfalz, Germany (to C.I.C.O.M.I. Compagnie Internationale pour le Commerce et l'Industrie, Luxembourg, Luxembourg).

Apparatus and Method for Calendering Plastic Sheet Material. No. 2,946,087. A. H. Haroldson, Newark, E. A. Mulrooney, Jr., New Castle, and W. P. Hogan, Newark, Del. (to Continental-Diamond Fibre Corp., Newark, Del.).

Presses for Thermosetting Compositions. No. 2,946,091. W. S. Fraula, Ridgewood, N. J., and H. M. King, Dearborn, Mich. (to American Brake Shoe Co., New York, N. Y.).

REPRINTS

P. B. Nortman Article
"Markets for Flexible Foams"
A comprehensive study of the markets for polyurethane, vinyl, and latex foams by fields. Special emphasis on urethanes.

50¢ per copy

PLASTICS TECHNOLOGY
630 Third Ave.
New York 17, N. Y.

Current Market Prices

This listing is as comprehensive and up-to-date as possible. The full listing will appear regularly, while intervening issues will carry a brief tabulation of price changes and additions.

Suppliers whose products do not appear are invited to submit their price data for inclusion in the published listing, as well as any price changes and additions promptly as they occur in order to assure maximum accuracy and value of the listing.

As can be seen, trade names or other company-originated names do not appear in the published tabulation. Products are grouped under their chemical names or chemical types. Any new products to be added to the list should also be so identified by the supplier firm. With the published listing, any questions on prices for specific products should be referred to us. We, in turn, can inform you of the suppliers whose product prices are included in our published listing and, similarly, refer these requests directly to the appropriate supplier(s).

Prices in general are f.o.b. works. Ranges indicates variations in grade, quality, quantities, and geographical locations of customers. No guarantee of these prices is made, and spot prices should be obtained from the individual suppliers.

Adhesives

Chloroprene type	gal.	$1.50 /	$1.60
Epoxy type	lb.	1.33 /	2.00
Silicone type	lb.	1.64 /	10.80
Thiocyanate type	lb.	.1725/	.20

Catalysts

Ammonium thiocyanate	lb.	.1725/	.26
Peroxide, acetyl, 25% in DMP	lb.	1.75 /	4.00
Benzoyl, dry, 96%	lb.	.88 /	2.00
Wet, 50% paste in TCP	lb.	.89 /	2.25
In silicone fluid	lb.	2.75 /	4.25
In BBP	lb.	3.00 /	4.25
Caprylyl, liquid, 50% in mineral oil	lb.	4.45 /	5.00
In DOP	lb.	5.00	
Cyclohexanone, 45% paste in DBP	lb.	3.00 /	4.00
Powder, 85%, in DBP	lb.	2.00 /	3.00
p-Cyclobenzoyl, paste, 50%			
In mineral oil	lb.	4.25 /	5.00
In TCP	lb.	5.00	
2,4-Dichlorobenzoyl, 50%			
In silicone oil	lb.	4.25 /	5.00
40% in silicone oil	lb.	5.00	
Di-t-butyl	lb.	2.00 /	4.00
Other peroxides	lb.	2.05 /	5.00

Colorants

Black, std.	lb.	.90 /	4.10
Gel coats	lb.	.61 /	.86
Carbon black paste	lb.	.65 /	.74
Bone blacks	lb.	.175 /	.2775
Iron oxide	lb.	.15 /	.23
Lampblack	lb.	.1225/	.175
Masterbatch	lb.	.60 /	.63
Paste (for epoxies)	lb.	1.58 /	2.15
Paste dispersion	lb.	.85 /	1.90
Paste concentrate	lb.	.82 /	1.20
Pigment dispersion	lb.	.83 /	1.15
Colloidal dispersions	lb.	.51 /	1.145
Aqueous	lb.	.115 /	.395
Blue, std.	lb.	.90 /	2.75
Concentrate	lb.	.95 /	3.00
Masterbatch	lb.	.85 /	1.13
Pearl	lb.	1.38	
Metallic	lb.	.02	
Paste (for epoxies)	lb.	1.25 /	2.60
Paste dispersion	lb.	.85 /	2.40
Paste concentrate	lb.	.78 /	.80
Phosporescent	lb.	.24	
Brown, std.	lb.	.87 /	4.00
Copper tinsel	lb.	.10	
Gel coats	lb.	.59 /	1.04
Iron oxide	lb.	.15 /	.24
Metallic bronze	lb.	.02	
Paste (for epoxies)	lb.	1.18 /	1.47
Paste dispersions	lb.	.75 /	1.70
Paste concentrate	lb.	.65 /	2.30
Gold, metallic	lb.	.21	
Paste dispersions	lb.	1.40 /	1.60
Tinsels	lb.	.10	
Gray, gel coat	lb.	.59 /	.84
Paste (for epoxies)	lb.	1.40	
Paste dispersion	lb.	1.45 /	2.20
Green, std.	lb.	.90 /	3.25
Pearl	lb.	.10	
Concentrate	lb.	.95 /	3.00
Metallic	lb.	.21	
Phosphorescent	lb.	.24	
Masterbatch	lb.	1.20 /	1.23
Paste (for epoxies)	lb.	2.86	
Paste dispersions	lb.	.85 /	2.70
Paste concentrate	lb.	.80 /	2.15
Chromic oxide	lb.	.45 /	1.40
Orange, dry	lb.	.49 /	3.50
Gel coat	lb.	.75 /	1.05
Paste (for epoxies)	lb.	1.58	
Paste dispersion	lb.	.55 /	2.80
Paste concentrate	lb.	1.58	
Purple, pearl	lb.	.10	
Red, std.	lb.	.1425/	5.00
Concentrate	lb.	2.25 /	2.50
Iron oxide	lb.	.0475/	.205
Metallic	lb.	.021	
Masterbatch	lb.	.75 /	.88
Paste (for epoxies)	lb.	2.35 /	3.77
Paste dispersions	lb.	.90 /	3.05
Paste concentrate	lb.	5.42 /	6.49
Venetian	lb.	.065 /	.1325
Silver, metallic	lb.	.0165	
Paste (for epoxies)	lb.	1.55	
Paste dispersion	lb.	.85 /	1.45
Paste concentrate	lb.	1.02	
Tinsels	lb.	.10	
Yellow, std.	lb.	.12 /	3.50
Gel coat	lb.	.61 /	1.03
Masterbatch	lb.	.90 /	.93
Concentrate	lb.	1.00 /	2.50
Iron oxide	lb.	.1225/	.1875
Paste (for epoxies)	lb.	2.15 /	2.55
Paste dispersions	lb.	.90 /	2.20
Paste concentrate	lb.	.65 /	2.87
White, std.	lb.	.54 /	4.00
Concentrate	lb.	.70 /	1.25
Gel coat	lb.	.59 /	.84
Masterbatch	lb.	.75 /	.80
Pearl	lb	.10	
Paste (for epoxies)	lb.	1.02	
Paste dispersion	lb.	.70 /	2.00
Paste concentrate	lb.	.705 /	.725

Fillers

Aluminum silicate pigments	ton	21.50 /	65.00
Barytes	ton	60.00 /	123.00
Paste concentrate	lb.	.705 /	.725
Calcium carbonate, ppt.	ton	55.00 /	75.00
Std.	ton	14.00 /	35.00
China clay	ton	40.00	
Flours	ton	50.00 /	106.00
Flocks, cotton	lb.	.12 /	.30
Rayon	lb.	.50 /	1.25
Nylon	lb.	.35 /	2.75
Mica	lb.	.075 /	4.44
Silica	ton	25.00 /	48.50
Whiting	ton	8.75 /	13.25

Miscellaneous

Anti-Fog	gal.	8.69 /	16.95
Anti-Static	gal.	3.57 /	8.50
Purging cmpd. (for injection)	lb.	.40	
Wetting agent (for dry coloring)	gal.	2.50 /	3.20

Mold Release Agents

Silicone type: Cmpds*	lb.	4.70 /	5.15
Emulsions	lb.	1.11 /	1.65
Fluids	lb.	2.78 /	6.00
Solvent emulsions	lb.	1.74 /	4.95
Stearates: Barium	lb.	.41 /	.46
Calcium	lb.	.39 /	.44
Magnesium	lb.	.42 /	.47
Zinc	lb.	.41 /	.48

Plasticizers

Adipate, Butyl Cellosolve	lb.	.45 /	.47
Didecyl	lb.	.265	
Dibutoxyethyl	lb.	.425 /	.46
Diisodecyl	lb.	.40 /	.44
Diisobutyl	lb.	.41 /	.44
Dioctyl	lb.	.40 /	.535
Diisooctyl	lb.	.40 /	.435
2-ethyl hexyl	lb.	.40 /	.44
Isooctylisodecyl	lb.	.40 /	.435
Isooctyl	lb.	.49 /	.535
n-Octyl decyl	lb.	.40 /	.44
Azelate, dioctyl	lb.	.445 /	.49
Epoxy, polymeric	lb.	.3225/	.3525
Monomeric	lb.	.3475/	.3775
Ester, Fatty Acid	lb.	.3525/	.3775
Oleate, Butyl	lb.	.24 /	.42
Puosphate, Tributyl	lb.	.50 /	.535
Tricresyl	lb.	.325 /	.36
Phthalate, Butyl Cellosolve	lb.	.35 /	.385
Cyclohexyl	lb.	.265 /	.305
Isodecyl	lb.	.26 /	.30
Dibutyl	lb.	.285 /	.43
Butyl octyl	lb.	.255 /	.30
Dicapryl	lb.	.265 /	.445
Dicyclohexyl	lb.	.465 /	.495
Diisodecyl	lb.	.265 /	.45
Didecyl	lb.	.265	
Diisooctyl	lb.	.26 /	.445
Dioctyl	lb.	.265 /	.305
Isooctyldecyl	lb.	.27 /	.45
Polymeric type	lb.	.39 /	.93
High-solvating	lb.	.37 /	.425
Ricinoleate type	lb.	.32 /	.35
Sebacate, Dibenzyl	lb.	.91 /	1.04
Dibutyl	lb.	.655 /	.745
Dioctyl	lb.	.5925/	.6825
Stearate, Butyl	lb.	.2225/	.3825
Octyl epoxy	lb.	.3925/	.4475
Tallate, Octyl epoxy	lb.	.3475/	.4025

Resins, Molding, Casting & Coating

ABS type	lb.	.45	
Acrylic	lb.	.46 /	1.08
Alkyd	lb.	.1325/	.137
Allyl (diallyl phthalate)	lb.	.95 /	3.20
Carbonate	lb.	1.30 /	2.25
Cellulosics:			
Cellulose acetate	lb.	.35 /	.68
Reprocessed	lb.	.25 /	.36
Cellulose acetate-butyrate	lb.	.40 /	.81
Reprocessed	lb.	.35 /	.45
Cellulose propionate	lb.	.40 /	.81
Ethyl cellulose	lb.	.67	
Reprocessed	lb.	.30	
Epoxy, liquid	lb.	.62 /	1.41
Solid	lb.	.51 /	1.31
Fluorocarbons	lb.	9.75	
Furane	lb.	.75 /	1.00
Liquid	lb.	.32 /	.44
Melamine coating solns	lb.	.3275/	.4375
Phenolic	lb.	.207 /	.7175
Coating solns	lb.	.305 /	.3525
Polyamide	lb.	.98 /	1.85
Graphite-filled	lb.	1.40 /	1.83
Heat-stabilized	lb.	1.09 /	1.55
Molybdenum sulfide-filled	lb.	1.19 /	2.10
Polyester, powder	lb.	.26 /	.545
Coating	lb.	.0975/	.1275
Polyethylene, low-density	lb.	.2375/	.615
Medium-density	lb.	.2375/	.6425
High-density	lb.	.275 /	1.29
Polypropylene	lb.	.42 /	.68
Reprocessed	lb.	.50	
Polystyrene	lb.	.17 /	1.34
Reprocessed	lb.	.15 /	.26
Polyurethane	lb.	1.30 /	7.50
Silicones, casting	lb.	7.50 /	11.40
Molding	lb.	2.40 /	3.55
Urea coating solns	lb.	.205 /	.27
Vinyl, dispersion grade	lb.	.24 /	.325
Molding	lb.	.185 /	.66
Reprocessed	lb.	.19 /	.22
Vinylidene	lb.	.205 /	.32
Latex	lb.	.45 /	.52

Solvents

Ketones: Acetate	lb.	.08 /	.22
Methyl isoamyl	lb.	.175 /	.315
Esters: Ethyl acetate	lb.	.125 /	.2675
Isopropyl acetate	lb.	.115 /	.255
n-Butyl acetate	lb.	.145 /	.285
Alcohols: Isobutyl	lb.	.13 /	.27
n-Butyl	lb.	.155 /	.295

Stabilizers

Alkyd tin mercaptide, liquid	lb.	2.50 /	3.15
Barium-cadmium complex, liquid	lb.	.50 /	.585
Solid	lb.	.97 /	1.25
Barium-cadmium laurate	lb.	.87 /	.90
Myristate	lb.	.72 /	.75
Barium-cadmium-zinc complex	lb.	.54 /	.56
Barium-zinc, liquid	lb.	.58 /	.615
Powder	lb.	.375 /	.44
Complex	lb.	.47 /	.50
Cadmium-barium, powder	lb.	.68 /	.895
Chelating agent, liquid	lb.	.57 /	.84
Cadmium-containing	lb.	.84 /	.87
Zinc-containing	lb.	.62 /	.80
Organic complex, liquid	lb.	.57 /	.845
Strontium-zinc laurate	lb.	.72 /	.75
Zinc, liquid	lb.	.48 /	.52

Domestic Production and Sales of Plastics and Resin Material, September and October, 1960

Following are the partly estimated and revised statistics for the domestic production and sale of plastics and resinous material during themonths of September and October, 1960. Units listed are in pounds, dry basis unless otherwise specified. Data on alkyds and rosin modifications have not been included since their use is primarily limited to the protective coating industry.

	September, 1960		October, 1960	
	Production	Sales	Production	Sales
Cellulose Plastics:				
Cellulose acetate and mixed ester:				
Sheets, under 0.003 gage	1,787,850	1,906,694	1,613,735	1,577,843
Sheets, 0.003 gage and over	2,185,247	2,159,393	2,044,024	1,954,050
All other sheets, rods, and tubes (including other cellulose plastics)	789,645	899,035	823,144	1,003,428
Molding and extrusion materials (including other cellulose plastics)	7,655,215	7,647,297	7,019,351	7,526,064
Nitrocellulose sheets, rods, and tubes	50,556	110,310	64,458	88,636
TOTAL	50,556	110,310	64,458	88,636
	12,468,513	12,722,729	11,654,712	12,150,021
Phenolic and Other Tar-Acid Resins:				
Molding materials	15,718,142	22,046,601	16,406,949	16,713,559
Bonding and adhesive resins for—				
Laminating (except plywood)	6,773,935	4,552,434	5,473,682	3,794,398
Coated and bonded abrasives	1,202,395	1,379,231	1,069,893	961,584
Friction materials (brake linings, clutch facings, and similar materials)	1,236,492	1,041,634	1,240,990	1,026,939
Thermal insulation (fiber glass, rock wool)	4,115,001	4,283,018	4,343,732	4,276,125
Plywood	5,128,202	4,662,630	4,300,960	3,282,432
All other bonding and adhesive uses	6,422,650	6,736,095	5,900,906	5,546,185
Protective-coating resins unmodified and modified except by rosin	1,933,941	1,773,835	1,582,437	1,317,660
Resins for all other uses	3,282,373	2,963,791	3,788,689	3,422,846
TOTAL	48,813,131	49,439,269	44,108,238	40,341,728
Urea and Melamine Resins:				
Textile-treating and textile-coating resins	2,137,194	2,281,256	2,321,707	2,288,531
Paper-treating and paper-coating resins	2,542,365	2,294,753	1,844,562	1,863,102
Bonding and adhesive resins for—				
Laminating	3,723,823	2,410,909	3,214,285	2,446,806
Plywood	7,813,194	7,461,671	7,251,552	6,939,621
All other bonding and adhesive uses	2,594,820	2,788,385	3,037,315	2,490,740
Protective-coating resins, straight and modified	2,779,779	3,325,879	3,437,558	2,248,063
Resins for all other uses, including molding	10,224,626	10,291,232	9,614,349	9,986,722
TOTAL	31,815,801	29,854,085	30,721,328	28,263,585
Styrene Resins:				
Molding and extrusion materials:				
Straight polystyrene	25,815,558	21,943,583	25,013,810	22,308,771
All other	29,508,217	26,129,383	30,346,650	25,323,655
Protective-coatings	5,319,772	5,635,827	45,491,501	5,170,111
Textile and paper treating and coating resins	5,666,824	4,214,219	6,618,446	4,588,530
All other uses	12,325,281	18,370,446	13,270,258	17,726,179
TOTAL	78,968,652	76,293,458	80,740,665	95,117,246
Vinyl and Vinyl Chloride Resins:				
Polyvinyl chloride and copolymer resins (50% or more PVC) for—		7,661,716		9,175,730
Film (resin content)		11,094,775		11,109,097
Sheeting (resin content)		25,115,747		25,489,865
Molding and extrusion (resin content)		5,570,849		5,174,867
Flooring (resin content)		15,723,381		15,194,336
Protective coating (resin content)		3,922,286		2,887,167
All other uses (resin content)		9,510,102		11,304,297
All other vinyl resins for—				
Adhesives (resin content)		4,883,649		5,087,145
Protective coatings (resin content)		2,341,568		1,771,376
All other uses (resin content)		11,036,105		10,620,071
TOTAL	97,790,667	96,860,178	104,584,095	97,813,951
Coumarone-Indene and Petroleum Polymer Resins	20,066,079	19,639,605	19,170,694	19,002,131
Polyester Resins:				
For reinforced plastics	9,173,808	8,167,689	9,857,930	7,956,615
For all other uses	1,648,649	1,244,217	2,270,204	1,822,673
TOTAL	10,822,457	9,411,906	12,128,134	9,779,283
Polyethylene Resins:				
For film and sheeting		36,328,292		37,767,225
Molding materials		15,669,284		15,319,486
Extrusion materials		13,118,333		14,578,468
For all other uses		41,265,222		40,427,535
TOTAL	109,338,553	106,381,131	112,885,966[1]	108,092,714[2]
Epoxy Resins:				
For protective coatings		1,503,497		1,510,876
For all other uses		2,611,024		2,598,429
TOTAL	5,093,796	4,114,521	5,747,666	4,109,305
Silicone Resins	486,132	454,102	394,307	377,262
Miscellaneous Synthetic Plastics and Resin Materials	25,371,286	21,164,717	26,886,058	21,397,288
GRAND TOTALS	441,035,667	426,335,701	449,021,863	436,444,519

[1] 17.1% produced by the low-pressure process.
[2] 15.2% produced by the low pressure process.
SOURCE: United States Tariff Commission, Chemical Division.

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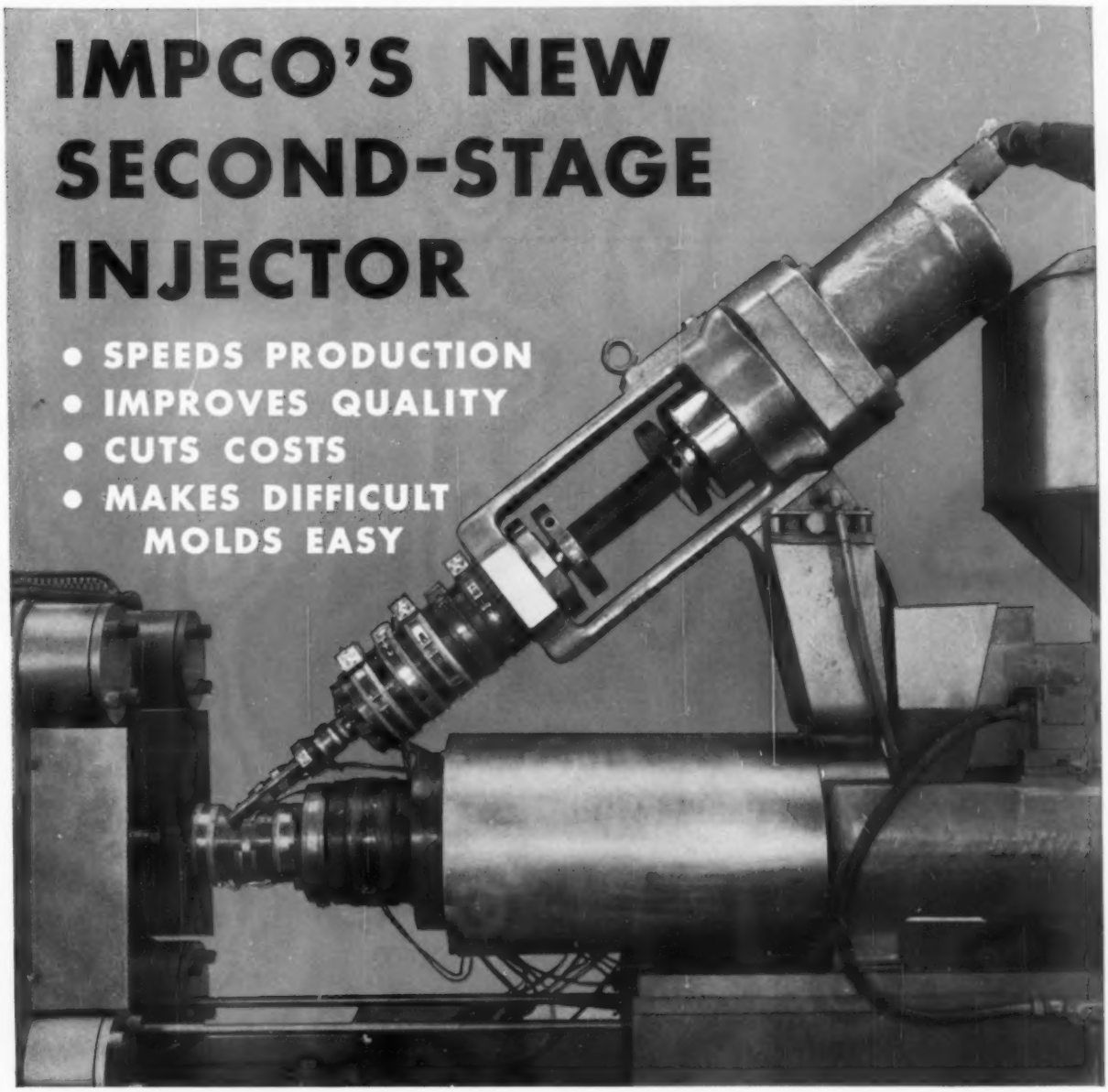

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